Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 72 NEW YORK, SATURDAY, JULY 17, 1915 Number 3

Illinois Licensing Law

A LAW for licensing structural engineers in Illinois is now on the statute books. Without a doubt it could be bettered—one would certainly think so, judging by both the friendly and inimical criticism which has come to this journal—but it accomplishes its main object, that of removing the engineer from the restraining yoke of the architects' licensing bill. Many there were who felt that the best procedure for the engineering profession would have been to have secured the repeal of the architects' licensing law. This being impossible of accomplishment the only alternative was to license structural engineers and give them the rights which they have been so long denied. The Engineering Record trusts that the passage of the measure, abstracted on page 71, will not encourage other States to go recklessly into the licensing of engineers. The Illinois conditions were exceptional.

The State and Liability Insurance

THE first annual statement of the New York State fund created under the Workmen's Compensation Act, which went into effect July 1, 1914, should interest contractors, as well as insurance men. The premiums charged on policies written under this act were 20 per cent lower than those charged by private companies. Yet the State fund has earned a 20 per cent dividend, after paying all losses and setting up large reserve funds. It is likely that the State will prove to have a great advantage over any insurace company, in that it is more free from demands for ridiculously large damages. In many instances the damages awarded by juries against private companies have been out of all reason, being many times the sum the injured could have earned if he had lived to be a hundred. To award damages in excess of earning power is, to the reckless or worthless employee, an invitation to get hurt. The lesson of this State insurance fund is that the country can adequately take care of those injured in industrial and public work at much less expense than has been the rule under the damage suit system. This lesson should be driven home to all those having to do with framing and enforcing liability laws.

Fostering Interest in Conventions

THERE has been a decided change, of late, in the methods which local committees of engineering societies are adopting to foster interest in annual conventions. One of the things to be desired at such meetings is a large and representative attendance, but with few exceptions, the measures employed heretofore to achieve this result have indicated a lack of appreciation of how to go about the work. The reason is that committees in charge have failed to realize the value of intelligent advertising and have proceeded on the assumption that by merely mailing a printed program their duty has been performed. Different tactics are being followed this year by the New England Waterworks Association, which will hold its annual convention in New York, Sept. 7 to 9 inclusive. As a forerunner of other announcements there has been mailed to each member a picture postal card showing in an ingenious cross-sectional view the spectacular work of laying a 36-in. flexible joint pipe line across New York Harbor, a million dollar job of the Catskill aqueduct work, which will be inspected during the convention. Other postals, dealing with different phases of the meeting, are to follow, so that the members of the association will be reminded of the event, not once, but at regular intervals from now until September. The scheme is nothing more than the "follow-up" system which has been used in other fields to arouse curiosity and create interest, but it indicates on the part of a technical society an appreciation of business methods and the value of publicity properly applied.

Patented Materials in Public Work

IT is clear to those who read carefully Mr. Whinery's article on page 73, advocating certain changes in the relations of State, contractor, and patentee of processes or materials employed in highway or other forms of construction, that the point at issue is not the relative merits of patented and unpatented materials or methods in themselves, but rather the abuses which have attended the award of contracts in which patented materials have been involved. In other words, a road in which patented processes or materials are used may give as good, or better, service under traffic as some other type of construction not controlled by commercial interests, but in the use of patented materials on public works difficulties and complications have arisen which can only be solved by a frank discussion of the trouble and its remedy. In the case of a State or city highway contract, where a patented pavement is admitted under the specifications, it is common practice to require the patentee to quote a price at which his material will be delivered to contractors submitting bids. This opens the way for a "favored contractor" to receive, surreptiously, a cut-rate price, thereby giving him an advantage which his competitors, who are bidding upon the figures openly published, do not enjoy. Thus, in spite of the fact that the favored contractor's bids on all the other items of the work may be high, it is still possible for him to secure the contract as low bidder. If, however, the other bidders could have availed themselves of the reduced price on the patented products, the favored con-contractor would cease to exist, and the State or city would be able to save an appreciable amount in construction costs. This, in brief, is the malady which Mr. Whinery would cure by eliminating dealings between contractor and patentee and having the State or city pay the royalty directly. Highway officials will do well to give to the proposed changes very careful consideration, for they point to economies in the cost of work and a square deal for contractors who submit bids in good faith.

Time by the Forelock

IN business and in industry there is a growing appreciation of the value of standard practice instructions. They allow the best experience in the organization to be used, even when the most competent men are away. Another advantage is that methods are never so severely analyzed as when they are put down on paper and passed around for the scrutiny of the staff. The errors in methods are then quickly discovered, while every effort is made to find the best possible solution for every difficulty. The experience of a staff, or of a group of men, can thus be more quickly focused than in almost any other way. An excellent example of standard practice instructions, drawn up so that the counsel of the best men in the organization may be at hand in every emergency, is afforded by Mr. Allner's article on ice fighting at the Holtwood plant, on page 66 of this issue. The precautionary measures adopted at the very beginning of the critical season in removing the screens in front of one of the intake openings of each unit, the close watch kept upon the exciter and change in the forebay, to give the very first indication of danger, the warming of chambers of units which had been shut down and of the exciter kept in reserve, and the minuteness of instructions as to procedure when a run of ice is certain, form a campaign of defense that is truly admirable. One can readily appreciate, even if one is without experience in the operation of a hydroelectric plant, that great importance must be attached to continuity of operation. The industries dependent upon this plant for their power would be seriously crippled if the power should suddenly fail and the reserve stations were not prepared to take up the load. Of course, one of the precautionary steps is to warn the reserve steam stations in ample time and if all of the defensive measures should prove unavailing, the only loss would be that occasioned by the cost of steam operation in place of the hydroelectric. To show how successful these measures have been Mr. Allner, in next week's issue, will tell in detail how a heavy run of ice in January of this year was successfully fought.

Monolithic Brick Pavements

A DISTINCT advance in the construction of brick pavements is marked by the type at Paris, Ill., described by W. T. Blackburn on page 54 of last week's issue of this journal. Practice, undoubtedly, has been drifting in the direction of a firm support for both wood block and brick pavement surfaces, and there is no special reason why, if a rigid base proves entirely satisfactory for these types, the same construction should not be used for stone block. Mr. Blackburn and A. J. Parrish, the contractor, have, however, developed a method whereby their entire pavement is laid practically at one time, thus insuring the maximum of bond possible between the base and the lower side of the vitrified blocks.

The chief advantage that should be expected from this type of pavement is the elimination of the hollow spots, explanation for which was offered in the theory of Mont Schuyler discussed at length in this journal July 3, page 3. Mr. Blackburn, in summarizing the advantages of the type of pavement he describes, referred to this point. If further study of Mr. Schuyler's theory should prove it to be correct—and from examinations this journal has been able to make, it seems to be tenable—there can be no question that this type will very rapidly supersede that in which a sand cushion is used. Already a number of cities have adopted the lean mortar cushion, placed, however, after the concrete base has set. While undoubtedly this cushion must act to some extent as a bond between the base and the brick, one cannot expect as good results as when the Paris method is adopted.

This type of construction naturally raises the question as to the strength of the bond between the base and the comparatively smooth surface of the vitrified brick. Upon it depends the extent of the beam action brought into play in spreading the load over a considerable area. Tests to determine the bond strength would be of interest, for should they prove to be high, so that considerable resistance could be expected to the horizontal shearing forces, the adoption of a quite thin reinforced concrete base would be possible. In fact, one city is now considering the advisability of attempting the Paris type with a base thickness of only 3 in., figuring that with the grouted block and monolithic action through a slab depth of 7 in. there will be ample strength for all except the very heaviest load.

It will be objected that this type of pavement will be very difficult to open up for sub-surface repair and construction work. It will be difficult, of course, but the Engineering Record has no patience with an argument which leads to the condemnation of a type of construction, otherwise entirely satisfactory, merely because of increased difficulty of disturbing a small percentage of the surface. Those who attach great weight to that argument put themselves in the false position of selecting inferior construction for 90 per cent or more of the pavements in order that they may be entitled to tear up the remaining 10 per cent at the slightest provocation.

The inherent advantages of the Paris type of pavement are such as should result in its speedy adoption elsewhere. It represents the farthest step in a development which has been pretty clearly sensed for some time.

Engineering Administration Courses at Massachusetts Institute

WITH the graduation exercises the past month, the Massachusetts Institute of Technology completed its first year of the new course in engineering administration. It is naturally much too early to make a full statement as to its real value, for, as one of the professors said, it is not easy to judge of the success of any line of education until the young men who are instructed have had a chance to try it out in real life. But with this consideration set aside the course gives evidence of success. It is an option beginning in the second year, and only sophomores undertook the work the past year. In 1915-16 there will be second and third-year students taking the course, while in 1916-17 students will have taken the full course.

The philosophy of the combination of technical engineering studies and those of business administration is self-evident. Till recently the heads of engineering corporations have been either men who began at the bench and learned the business in the office, or else men who were in the office and learned engineering in that inefficient school, the efficient shop. It is the institute's plan to furnish parallel and correlated studies which shall teach business and engineering together. There is no intention of making skilled accountants in any sense of the word, but to furnish the fundamentals of accounting to men who wish to accept financial responsibility. The student will learn the terminology of bookkeeping, the meaning of assets, liabilities, good-will, franchises, of the profit and loss account, the theory of accounts in general and of depreciation. Cost accounting, bonds, sinking funds, amortization, etc., are included in the studies, as are the functions of the stock and other exchanges, the broker, and similar agencies in the marketing of securities and stocks. Transportation and industrial organization will be taken up in the same analytical way.

Not only is the course adapted to business in connection with engineering generally, but options are provided which correlate the special work to civil, mechanical, electrical and chemical engineering, each of which is taken up from the point of view of the specialty, different in some related details from the other options.

From the opening of the course its numerical success was assured. Fifty-two students enrolled in September, 1914, as against about an equal enrollment in electrical engineering and from eighty to ninety in the mechanical and civil engineering courses. It may be that some of the students imagined that the course was to be an easy one and the Technology degree was to be gained by a cut comparatively short. It is unnecessary to say that such hopes were without foundation.

From the students' point of view the new course has been satisfactory, and certain of the lectures really popular. The accounting, which has been open to those not registered for the full course, has attracted eighty-seven men, 70 per cent more than the course proper, while the lectures on banking and finance have been taken by 125 students. It is further true that these numbers would have been larger, but for the difficulty in arranging for the courses in an already well-filled schedule.

One of the interesting features in connection with the establishment of the course was the thorough consideration and digestion of it in advance of adoption by trained and successful business men. It had its origin in the alumni association of the institute. It is the habit of this body to take up important questions at the association's meetings and at the meetings of its council, and subject them to the scrutiny of committees which report in regular engineering fashion. It is along the lines of the report of a committee of this kind that the course was established. It is the first of its kind in the country, but it seems to fill the bill so well that it is likely to be a pattern for similar work in other institutions.

Revenue from Sewage

WHILE sanitary engineers have long realized the inherent possibilities of sewage sludge as a fertilizer, very few plants, in this country at least, can boast of deriving any revenue from the sale of the waste material. In fact, works operators generally feel satisfied if they can remove sludge from the tanks and dispose of it inoffensively, without considering the matter of profit and loss. At Baltimore, however, the Sewerage Commission, which controls the operation of the Back River disposal plant, comprising settling and sludge digestion tanks as well as sprinkling filters, has been able to sell a portion of the plant's sludge to farmers, who use it in developing their crops. For a year past, according to Calvin W. Hendrick, chief engineer, the receipts from the sale of sludge, at the price of 35 cents a load, which the farmers pay, have amounted to about $5000. From the digestion tanks a gravity flow pipe leads to the road so that the matter of loading into tank carts is merely a matter of opening up a valve. It is interesting to note that the sludge is taken not only from the tanks directly but also from the drying beds, and that the preference for the material from the two sources is about equally divided. Mr. Hendrick's policy is to adopt every measure which will help to make the works pay their operating costs, and the sale of sludge is only one of these measures. All of the power for lighting, pumping and other mechanical uses is generated by passing the sewage effluent through a small hydroelectric plant, and there is being developed a plan for the recovery of grease at the influent end of the works. In fact, there are at the Sewerage Commission's offices two bars of soap made as a sewage plant by-product. In the light of present sanitary knowledge prospects for the recovery of sewage works wastes on a large scale which will be commercially attractive have never been considered bright, but the fact that Baltimore is deriving some revenue from its sludge and is taking up the problem of grease recovery suggests that the operators of plants in other cities, after they have developed the technical end of the maintenance routine, may well devote some thought to the matter of getting from their works something more than chemical and bacterial analyses.

Why One Contractor Will Bid Higher the Next Time

"WHEN the mixer starts, Hell breaks loose. The engineers take delight in standing by until we are ready and then in finding something to delay the work while the mixer crew waits." Such is part of a superintendent's report, explaining his bitter disappointment to his contractor employer for placing less than 400 cu. yd. of concrete in two months on a Government contract that could easily be pushed several times as fast. The superintendent further explained that it mattered not how true or how well forms and steel were placed, the work was never done correctly unless it was done the engineer's way. His way always cost more and there was no arguing with him that another method would produce equal results. Surely a remarkable report coming as it did from one of the oldest employees of a firm of contractors noted for fairness and ability to do good work. If the contractors were not well acquainted with their superintendent they would be inclined to think he was partly to blame, but difficulties of this kind have never risen before in the twelve years of his employment, and careful investigation on the job showed that the report was not exaggerated.

A few notations on the form sketch sent in by the superintendent indicate the needless care with which the structure had to be built. Concrete in side walls, only 11 ft. high, could not be poured from the top but had to be deposited in several layers, the upper panels of the forms being left off for that purpose, thus causing much delay. All forms were required to be set within ⅛ in. error and bars within ¼ in. The forms were complicated beyond possibility of description here.

The superintendent wound up his letter resignedly with the characteristic attitude of his company, "We will do the best we can." The contractors state that they instructed the superintendent to get the job done the engineer's way. But they added that this is the reason why work for this particular department of the Government costs so much more than private work. If this firm can again be induced to bid for work in this department, the prices will be considerably higher than those of the present contract. Of course, the occasional isolated case like the above gets more publicity than half a hundred regulation contracts where give-and-take, fair-and-square methods of procedure obtain. While anathemas are heaped on the unreasonable engineer, this is not the end of the story, for irreparable damage is done to the whole profession and to the particular organization with which he is connected. The news of his unreasonableness is sure to spread among contractors, and his attitude will be imputed to the department which he represents.

Catskill Water for New York City in 1916

THE statement in the 1914 annual report of the Board of Water Supply of the City of New York—which was issued this week—to the effect that the Catskill aqueduct, for the delivery of the first installment of 250,000,000 gal. daily, was 93 per cent completed on Jan. 1 of this year and will be ready for service in 1916 is a reassuring reminder that the grave danger of a water famine, which appeared to be so imminent only a few years ago, is now effectively removed. Only two links in the 126-mile line connecting the Ashokan reservoir in the Catskills with the Silver Lake reservoir in Staten Island, the southerly terminal of the waterway, remain unfinished. Of these the first is a 900-ft. stretch of tunnel to replace a section of the Moodna siphon, where leakage developed, while the other is the Narrows siphon, the flexible-joint submarine pipe line which will carry the aqueduct flow under New York Harbor to the borough of Richmond. Pending unforeseen requirements, which may be indicated by service tests, the contracts for these two pieces of work constitute all construction essential to the delivery of Catskill water from the Esopus watershed to the five boroughs of New York. The remainder of the aqueduct is practically ready for service.

With its many miles of conduit in open cut, its huge dams, deep rock tunnels, submarine pipe lines and other equally spectacular features, the work which has been directed so effectively by J. Waldo Smith as chief engineer is on such a huge scale and is so well known to the profession—for scores of engineering societies have made it a feature of inspection trips during annual conventions—that the official figures of progress, as given in the report for 1914, will impress upon the thousands of engineers who have tramped over the line that the aqueduct which they saw in the making is now about ready to carry water.

As to the reservoirs, the Ashokan, at the north end of the line, is finished and water was impounded in it throughout the year. At the Kensico dam 806,000 cu. yd. of masonry, of the total amount of 872,000 cu. yd., have been placed and, incidentally, a masonry placing record of 84,450 cu. yd. a month was established. Excavation and embankment for the Hill View reservoir have been finished and the concrete lining was well along toward completion at the end of the year. Forty per cent of the work on the Silver Lake reservoir, the terminal basin of the system, had been done by the end of 1914. The aqueduct proper has been tested, and the work within the city limits necessary to deliver Catskill water to the five boroughs of New York was 98 per cent finished. The only further operations necessary are the installation of some of the valves and the construction of valve chambers for the distribution connections. Practically nothing further remains to be done on the pipe lines in the boroughs of Brooklyn, Queens and Richmond, except the Narrows siphon.

No less impressive than the technical details of the work are the figures of its finances. Disbursements during the year for all purposes were about $14,000,000, bringing the total cash amount disbursed for the purposes of the Board of Water Supply since its organization on June 9, 1905, to $123,000,000. The registered liabilities to Jan. 1, 1915, were $11,000,000 and the total obligations $134,000,000. The amounts of contracts finished and now in progress aggregate $99,000,000, of which $11,000,000 were done during 1914.

But the work of the Board of Water Supply is by no means finished. The additional water supply plans contemplate the development of Schoharie Creek, north of the Esopus watershed, and from this source 200,000,000 gal. per day will be added to the Esopus yield. In fact, borings have already been made to determine a location for the Schoharie dam. Thus, while the closing chapters are being written for the first and more important part of the project—the delivery of 250,000,000 gal. daily—work is ready to begin on the second installment for the ultimate capacity of about 500,000,000 gal. daily.

The news that New York will soon be receiving Catskill water is an announcement which means much to the engineering profession at large. It will impress upon a skeptical public that municipal work on a scale never before attempted can be prosecuted expeditiously and without scandal if properly qualified engineers are allowed to exercise authority unhampered by political interference. It is an argument, also, for long tenure of office for responsible department heads. With a few exceptions—and these due principally to the fact that their work was finished—the men who are directing the final operations on the aqueduct are those who were in office when the preliminary borings were being made and the plans and specifications drawn up. Organization is everything on a project such as the Catskill aqueduct, and the City of New York is now ready to reap the benefits of a policy which allowed the chief engineer of the Board of Water Supply to conduct the work in the way that his judgment dictated and to choose as members of his staff lieutenants qualified by training and experience to perform the duties expected of them.

Ice Fighting Is Systematized at Holtwood Hydroelectric Plant

Permanent Instructions to Operating Force Show Detailed Procedure to Prevent Shutdown of Main and Exciter Units When Frazil and Anchor Ice Are Running—Steam Used for Warming Turbine Chambers

By F. A. ALLNER

General Superintendent, Pennsylvania Water & Power Company, Baltimore, Md.

ICE FLOODS on the Susquehanna River are usual occurrences every year. In some years more than one ice flood is recorded in the lower course of the river, when the first high-water peak following the breaking up of the frozen river and its tributaries is not sufficient to carry out the bulk of the ice beyond the shallow reaches of the river. The up-river ice grounds then along the river stretch from Columbia down to York Furnace, where the river channel is very wide and shallow and intersected by a number of projecting islands. For a period of several weeks shifting ice jams form and break in the short space of a few hours until a temporary channel on the surface or below the ice is formed.

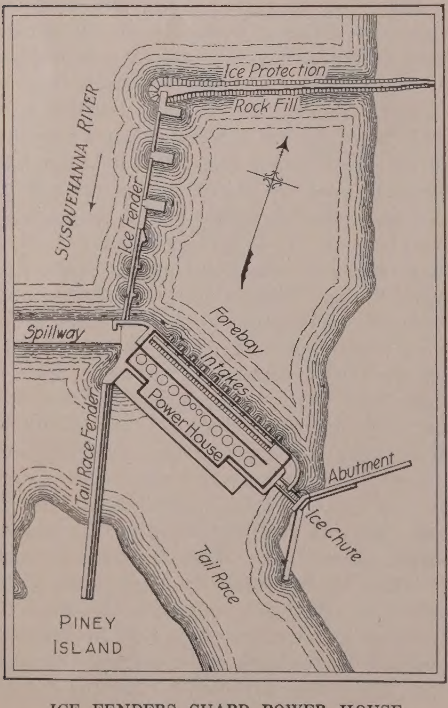
SECOND ICE FLOOD

The second ice flood then occurs toward spring when another high-water peak, produced by warm rains and thaws, washes down the residue of the first ice jam, plus the ice that has collected in the headwaters and tributaries subsequent to the first ice flood.

In some years the first high-water peak in January carries out all the up-river ice and the second ice flood brings down only such ice as has formed after the passing of the first ice jam, particularly when there has been a continued cold spell in February.

FIELD ICE DOES NOT AFFECT PLANT

None of the above ice phenomena have ever interfered with the operation of the principal hydraulic development on the river, the Holtwood plant of the Pennsylvania Water & Power Company, at McCall's Ferry, beyond a temporary reduction of head due to backwater in the tailrace, accompanied by a corresponding small reduction of station capacity. This is illustrated on the accompanying diagram giving station loads, forebay and tailrace elevation on Jan. 9, 1915, when the forebay rose almost 5 ft. in less than 30 min., the tailrace going up over 7 ft. in the same time. The largest reduction of station capacity during the passing of this ice jam did not exceed 8 per cent of the turbine rating.



ICE FENDERS GUARD POWER HOUSE

No operating precautions of any kind need to be taken at the Holtwood plant against ice floods, thanks to the excellent protection given to the plant by the natural formation of the river channel and by the layout of the plant. The current of the river always carries the bulk of the ice toward the York County shore, away from the power house. When the pond has been filled with ice over the whole width of the dam, the submerged intake arches, the floating booms between the ice piers and the rock fill on the up-stream side of the forebay have prevented any of the ice from entering the forebay. This has been true during the past five winters that the plant has been in operation.

FRAZIL AND ANCHOR ICE

There are, however, two types of ice formation that are apt to interfere more seriously with the normal operation of the plant if proper precautions are not taken upon the first sign of trouble. The reference is to frazil and anchor ice, which are of common occurrence at hydraulic plants in northern climates, but less frequent at plants in moderate climates. The Holtwood plant has been very successful in overcoming the difficulties from these sources. This is principally due to the careful planning and standardization of the precautionary measures to be taken by the operating force and in the working out of ice-handling devices that facilitate a quick diagnosis of and remedy for the trouble.

Some of the methods described in the following instructions had been in use for two or three winter seasons, but the complete standardization as given below was adopted only previous to last winter. Its beneficial effect is particularly noticeable in the handling of a very severe ice attack that occurred in January of this year.

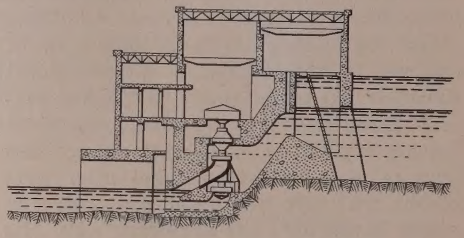
The instructions, in full, are as follows:

DIAGNOSIS

Apart from the possibility of trouble due to floating cake ice the operation of the generating plant may be interfered with by frazil and anchor ice. It is essential that the operator should have a knowledge of the conditions of formation and effects of these latter forms of ice in order properly to provide against trouble from them.

Frazil Ice.—Frazil ice is formed during cold weather and high winds in the absence of any protective ice coating on the lake. Under such conditions the water becomes chilled to a temperature a few thousandths of a degree below freezing point. Ice needles then appear, and by sticking to the racks or turbine parts choke off the water from the turbines or prevent the operation of the turbine gates. Ice thus formed persists in the lake until a rise in temperature, generally with the rising sun, and a decrease in the wind results in melting the ice needles or allowing them to form a surface sheet of ice. Dull and windy days with little prospect of the sun's rays piercing through the cloudy sky aggravate the difficulties a great deal.

Anchor Ice.—Ground ice is formed when there is no ice covering on the lake, or only a thin sheet of clear ice, when there is a cold night with clear sky. Anchor ice then forms on the bed of the river and is detached therefrom in huge masses of slush-like material when the temperature of the water is slightly raised, usually a little after sunrise. There are, therefore, certain definite weather conditions when frazil or anchor ice may be expected to form, and when these conditions occur the operator should be on the lookout for such troubles. Ordinarily trouble from such ice develops so quickly that it is essential to be prepared for it well in advance of the actual appearance of the ice. Instructions and drill on this subject must be rehearsed yearly.

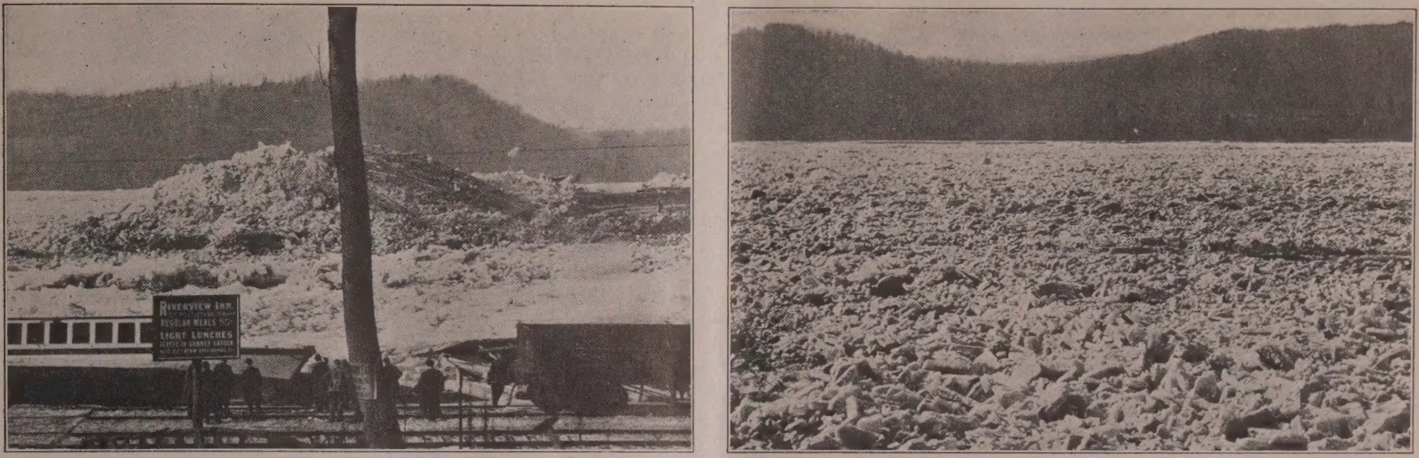


TRANSVERSE SECTION OF POWER HOUSE

DIAGNOSIS OF POSSIBLE ICE DANGER

Frazil or anchor ice cannot form until the water reaches freezing temperature; nevertheless, the operator should not be deceived by the gatehouse water thermometer showing a temperature a few degrees higher than freezing, since the water temperature in the lake may not be identical with the temperature of the water in the gatehouse. When frazil ice is possible, half-hourly examinations of a chain immersed in the flowing water of the forebay should be made for evidences of the ice needles.

It is also advisable on suspicious days to operate the No. 1 turbine-driven hand-control pump continuously at a fixed valve opening and observe its speed at short intervals. A decrease in speed, not explainable by external load conditions, sometimes accompanied by a rumbling noise in the turbine casing, will be one of the first indications of imminent ice trouble, and the morning hours preceding the peak load are often a favorite time for such ice trouble to begin. The responsibility for diagnosing imminent ice trouble in due time to prevent serious interference with service rests solely upon the switchboard operator, who



HEAVY ICE PILES HIGH IN WINTER ABOVE HOLTWOOD DAM ON THE SUSQUEHANNA RIVER

must be at all times alert to the danger and fully familiar with the precautions to be taken and methods outlined below for protecting the service.

PRECAUTIONS

Beginning Nov. 15 of each year (or earlier, if freezing weather sets in before that date) and until March 15, a set of four screens must be removed from a single intake of each main unit and its respective head-gate lowered to the closed position to prevent trash from entering the wheel-pits during normal operating conditions. [Each main unit at Holtwood has four intakes, controlled by head-gates. In front of each intake the water has to pass through an inclined screen area, built up in five sections, so that each main unit has twenty screen sections.]

The rack area of the whole power house should have been examined previously by a diver and all debris at that time collected on the racks should have been removed. It is always possible that floating trash may enter the intakes after the removal of the screens and particularly is it to be expected during ground-ice trouble, the effect of the ground ice being to gather up and float logs and stones from the river bed. The operator should look out for unusual noises in the turbines during such operation period and be prepared to take the proper action in case of fouling of the turbine gate rigging by trash.

During the open-winter season the gatehouse is to be maintained at a warm temperature by heat from the generator room and the gatehouse windows are to be kept closed. Particularly during ice troubles the operator should take special care in maintaining the highest possible temperature in the gatehouse.

PRECAUTION WITH EXCITERS

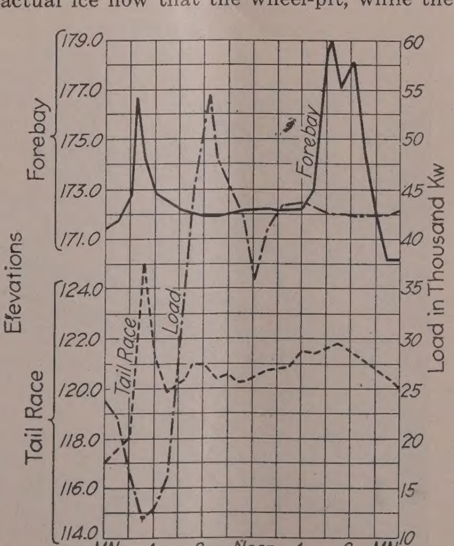
During the whole open-winter season one of the turbine exciters should have three of the screens removed. Ordinarily, only the motor-driven exciter and the turbine that has the intake protected by screens should be used. Direct-current station load and auxiliaries should be transferred or replaced as far as possible by alternating-current service. The battery always should be maintained in fully charged condition.

The dinkey fire during the open winter season should not be allowed to be withdrawn unless the river is completely frozen over from shore to shore and within a short distance from the crest of the dam. A convenient steam-hose connection should be held in readiness to feed steam from the dinkey when standing on the lower powerhouse track into the 1-in. compressed-air header on the downstream side of the pump tunnel.

FIGHTING IMMINENT ICE TROUBLE

In the event of imminent ice trouble the closed head-gates to each main unit are to be raised. As soon as other operating work of immediate urgency will permit, three or four top screens of another intake for each unit are to be removed or raised, and left in this position until the river is completely frozen over or all danger from ice trouble is passed. The operator wants to bear in mind that the ice, forming on the screens unexpectedly, may obstruct very quickly the flow of water to the turbines, so that there is hardly any water flowing into the pit. This condition is also accompanied by the danger of the screens crushing under the hydrostatic pressure when the difference of the water elevation in front and back of the screens exceeds 15 ft. The closed head-gate to each main unit must be raised immediately to insure that each main unit can carry approximately 50 per cent load should the screens of the other three intakes form a complete obstruction to the water entering the wheel pits. The subsequent raising of the screens on another intake will increase the capacity then to full load.

It is most important during occasions of actual ice flow that the wheel-pit, while the unit is running, be kept completely filled with water to avoid the possibility of the gate mechanism being frozen to the turbine casing, which condition will develop should the wheel-pit be partly or completely drained, allowing the outside air to enter the pit from the gatehouse. With the gate mechanism frozen it is impossible to move it by admitting pressure to the operating cylinder, and thereby the control of the unit is lost. A full wheel-pit is indicated by the pressure gages mounted on each turbine near the floor, which ordinarily indicate 14 or 15 lb. pressure. A full wheel-pit can be maintained during such conditions only by adjusting the gate opening on the turbine to a point approximately where the pit pressure attains a constant maximum pressure or permits the flow through the turbine to equal the flow into the wheel-pit. The above conditions must never be overlooked, as it is of prime importance that the unit be always under complete control, and delivering its highest feasible load while the station is operating under a reduced capacity.



LARGEST REDUCTION OF HEAD DURING PASSAGE OF ICE JAM JAN. 9 ONLY 8 PER CENT

FREEING MAIN UNIT FROM ICE

In the event of a main unit becoming inoperative due to ice on the operating mechanism or turbine passages, the head-gates of the unit affected are to be lowered and the pits drained. If load conditions permit, a speedy inspection of the wheel-pit is also advisable. Live steam is then to be admitted to the wheel-pits through the 1-in. air line from the dinkey. The object of this is to increase the air temperature in the pit, and thereby raise the temperature of the metal parts of the turbine and the concrete surfaces of the wheel-pit sufficiently to allow the adhering ice to be cleared away. It will be possible then to run the unit again until the flowing water has time to abstract the heat from the surfaces sufficiently to cause the ice crystals to adhere once more.

In general, however, it is expected that the main unit turbines will be less interfered with by ice than the exciters, since it would take longer to cool the more massive portions of the main turbines. Also, since the passages of these units are very large they would not become choked so quickly with adhering ice as the exciter turbines. It is advisable to keep the gate mechanism moving slowly so that the ice has no opportunity to freeze solidly around the numerous links, vanes, etc., and then all at once offer an excessive resistance to the moving of the gate mechanism.

Although serious danger of a complete choking up of the main units exists only during a long protracted run of frazil ice, it is nevertheless a possibility and the operator should endeavor to keep one main unit with its guide vanes closed, running on leakage and synchronized with the bus, without carrying any load. Such unit should be considered a spare, ready to be put into service so that another unit can be cut out and its wheel-pit thawed out. If enough steam can be spared from the dinkey, aside from the requirements for thawing out the exciter turbines, it is advisable to let steam also enter the water-filled pit of this reserve main unit, through the 1-in. air connection in the pump tunnel.

The filling of the turbine passages with ice can be evidenced by the decreased carrying capacity of the unit in proportion to its gate opening. The operator should, therefore, maintain a continuous observation of this feature through the floorman, so that he can quickly change over to the reserve unit and dispatch the thawing out of the ice-troubled turbines. He wants to bear in mind that it takes a comparatively shorter time to thaw out a unit with little ice obstructions than a unit that has the passages almost completely choked up. Consideration of an expected increase or decrease in the load curve, preparedness of the customers to take over a portion of their load by steam, will be the guiding factors for taking certain risks temporarily or of avoiding such chances. As a general rule, however, the operator should try to keep ahead with his station capacity over the load requirements by a safety margin of about 10,000 kw., until all ice danger has been removed.

The customers are to be notified of ice conditions upon the first indications of frazil or anchor ice and are to be kept informed at short intervals of the situation, so that they may be prepared to take over a portion of their load by steam, if necessary. Constant and the most accurate possible communication with customers is an important feature in the successful handling of the ice situation as a whole, and the operator's attention is to be called particularly to this point because a neglect in this respect has aggravated to a vast extent every occurrence of ice difficulties in the past.

FIGHTING IMMINENT ICE TROUBLE — EXCITER UNITS

The undisturbed operation of exciters during ice flow occasions is a most vital requisite for the continuity of the service. Although the battery can be relied on to supply, in an emergency, the entire excitation and direct-current station service for a limited period (from 10 to 50 min. depending on load conditions), the operator should never rely on this reserve for maintaining continuous service. The following method of operating exciters when ice trouble is imminent will usually bring the best results:

1. During the open-winter season the screens on one exciter are removed. At the times of imminent ice trouble the screens on the other turbine exciter should also be raised. If possible, however, neither waterwheel exciter should be in service and only the motor-driven unit is to be used. It is desirable that the head-gates on exciters Nos. 1 and 3 be open, but the guide vanes are to be closed, and the units run on leakage. Live steam is to be admitted from the 1-in. air line to at least one of the exciter wheel-pits, thus insuring that this unit can be relied upon as a reserve excitation supply.

In the event of No. 2 exciter alone not being sufficient to supply the direct-current demands of the station, one of the exciters, No. 1 or 3, is to be paralleled, with such a division of load that the water-driven unit has the guide vanes wide open up to the limit of the electrical capacity of the machine. In the meantime, of course, the other waterwheel exciter will be kept warm by live steam and if the good condition of this unit as spare has been insured, and also additional steam can be spared from the dinkey boiler, live steam should also be admitted to the 1-in. air line into the wheel-pit of the turbine exciter on the load. Constant watch is to be kept on the exciter turbines carrying the load for the slightest indication of a capacity reduction caused by ice troubles. Immediately then its load should be transferred to the reserve turbine and all thawing out efforts in the station must be concentrated on the keeping clear of the threatened exciter turbine.

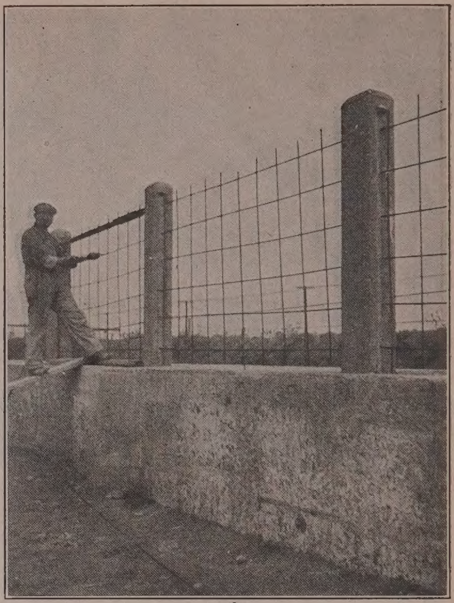
[An article in the next issue, also prepared by Mr. Allner, will tell in detail how a severe run of ice in January of this year was successfully fought.]

4½ Miles of Concrete Fence Flank Transit Route

Solid Slab 4½ Feet High on Sea Beach Line Improvement in Brooklyn Is Built in Place—Dovetailed Grooves for Expansion

THERE has recently been completed on the Sea Beach Line rapid transit improvement in Brooklyn, N. Y., about 4½ miles of reinforced-concrete fence built in place. This fence continues on both sides of the cut between Fort Hamilton Avenue and Eighty-sixth Street. The accompanying photograph shows the Twenty-second Avenue Station and the fence on top of each retaining wall.

This fence is 4 ft. 6 in. high, supported on reinforced-concrete posts 7 x 7 in. by 4 ft. 10 in. high, with alternate 7 x 9-in. posts for expansion, spaced 8 ft. 4 in. center to center. The latter posts were built with 1¾ x 3-in. grooves, dove-tailed to allow the expansion of the panels. The posts are reinforced by two ¾-in. twisted steel rods and four ¼-in. rods, one at each corner, and the panels by six ¼-in horizontal rods running through the posts and eleven ¼-in. vertical rods to each panel. All the rods are tied together by Curry tiers, so as to keep them in position and at proper spacing, as shown in one of the photographs.



PANEL REINFORCING RUNS THROUGH POSTS, AND IS HELD IN PLACE BY TIES

The posts were constructed first. The ¾-in. anchor rods extending into the retaining wall 12 in. are set in grout and are 5 ft. 6 in. long. Several days after the posts were cast the panels were built by the use of forms of good spruce lumber covered on the face with sheets of galvanized iron. The frames were made very rigid and thoroughly braced so that they could be used several times.

The concrete consisted of one part Portland cement, two parts sand and four parts grit (small pebbles) and was mixed by hand, as only a few yards were required to run 200 to 300 lin. ft. of fence in a day. Between March 15 and May 30, 1915, over 12,000 lin. ft. of fence were built, the balance having been finished the fall of 1914.

George W. McNulty, Inc., was the gen-

CONCRETE FENCES CAST IN PLACE, POSTS FIRST, PANELS AFTERWARD eral contractor for the Sea Beach improvement, and the D. Cuozzo Construction Company, Inc., was the contractor for the fence.

Subaqueous Pipe Taken Up and Replaced 3 Feet Lower

Improvements on Neponset River Work Near Boston Involved Use of Dipper Dredge to Raise Flexible Joint Line

By EDMUND M. BLAKE
Engineer in Charge, Massachusetts Board of Health

AMONG the problems encountered in widening and deepening the channel of the Neponset River near Boston was the removal of a 10-in. flexible joint cast-iron water pipe laid across and on the bed bed of the river in 1896 opposite the pumping station of the old Hyde Park Water Company below Readville. The pipe was relaid at a grade about 3 ft. lower than its original location. The Massachusetts State Board of Health had supervision over the work for which the Barge Canal Construction Company of New York secured the contract.

The land between the pumping station and the river is low and swampy and the water pipe runs from the station across that land, under the river and up toward the Readville district with the purpose of furnishing better fire protection to that district and to the car shops of the New York, New Haven & Hartford Railroad. The land on the other side of the river was originally low, but when the grade crossings at Readville were eliminated all of that area was filled in to quite a depth. This fill comes down very close to the river bank to allow for the laying of as many tracks as possible in the Readville freight yard, so that the pipe, after crossing the river, runs into a steep embankment with a heavy fill. There is a 10-in. gate near the old pumping station and another one on the opposite side of the river near the bank, but covered with about 12 ft. of fill. The gate box for this latter gate is set between two ties on the outer freight yard track. Furthermore, this 10-in. pipe crossing is located at a very sharp bend in the river with the railroad embankment on one side and a row of very large oak and elm trees on the pumping station side.

PIPE PROFILE PLOTTED

The water pipe was originally about 3 ft. above the bottom grade which it was necessary to obtain at this bend in the river for the new channel, and consequently it had to be lowered. No information was available as to the condition of the flexible joint pipe. A very careful cross-section of the old river channel was taken and the profile of the pipe was accurately plotted from soundings. This pipe is in continuous service for the supplying of drinking water as well as for fire protection, although a second 10-in. crossing about ½ mile downstream made it possible to remove this pipe without serious interference with the service, provided a large conflagration did not occur during the work. This latter emergency was fortunately not met with, but, as the river is very much polluted with the discharge from mills and tanneries above this point, it was necessary to do the work so that none of the river water could in any way remain in the relaid pipe or get into the system through the open ends of the old pipe during the work.

Several plans for the new crossing were carefully studied. It was finally decided to locate a new 10-in. gate on the pumping station side of the river near the bank and to place a 10 x 4-in. tee on the opposite side near the bank, running a 4-in. blowoff discharge pipe from that tee about 20 ft. downstream into the river at an elevation below the low water stage. The new 10-in. gate and the old one near the outer freight track, in connection with the 4-in. blowoff, would make it possible to clean out the pipe crossing thoroughly after relaying it and before putting it back into regular service. The space taken up by the new 10-in. gate and the 4-in. blowoff connection would make it possible to dispense with at least one flexible joint. It had been decided to use the old pipe again provided it was found to be in good condition, which was the case.

DIPPER DREDGE LIFTS LINE

A big dipper dredge was at work in this section, but the river was high, due to the spring floods, so that relaying the pipe under those conditions would be both difficult and costly. The Department of Public Works of the city of Boston then unexpectedly granted permission to remove the pipe without relaying it, as it had been decided by them at that time to put a new river crossing in at a point lower downstream where access to it would be easier.

Having one flexible joint to spare, it was therefore decided to arrange with the dredging contractor to pull out the old 10-in. pipe by the use of the dipper dredge, which was equipped with steel teeth extending beyond the lip of the dipper. Both gates on either side of the river were shut tight before starting to pull out the old pipe. Pits were also dug over the pipe on both sides of the river at the bank lines to release the earth pressure on the pipe. On the morning of March 21, 1913, the dipper dredge was brought into position, the dipper was carefully maneuvered until the teeth caught under the 10-in. pipe about in midstream and was then very slowly lifted. After several trials, the midstream joint was brought above the surface of the water, the lifting was continued slowly and the two adjoining flexible joints under water were opened fully, separated from the rest of the line and the two lengths were then pulled out and deposited on the banks. This was done without opening up the flexible joint first exposed. Chains, attached to the dipper and the pipe, were then used in pulling out the balance of the pipe, and in the whole operation only one flexible joint was broken and that only in a small section of the bell. The lead was all saved. Seven lengths, or about 84 ft. of pipe, were thus removed and placed on the bank on the pumping station side of the river, where they could be easily handled for cleaning, cutting and removal of lead.

Late in May, 1913, the city of Boston gave notice that it had abandoned its original plan of putting in a new crossing lower down and requested that we relay the old 10-in. pipe in its original location, except as to grade, as soon as possible. Plans were perfected rapidly, and on June 10, 1913, three bids were received for doing the work, all pipe and special castings and gates to be furnished by the State, as follows: T. H. Corrigan, Hyde Park, $1,490; Charles N. Taylor, Wellesley, $1,150; Crandall Engineering Company, Boston, $790.

The contract was awarded to the Crandall Engineering Company, which was required to furnish a bond in the sum of $500, and work was started under this contract on June 20, 1913. In dredging out the river bottom at the pipe crossing, it was impossible to deposit any material on the side of the railroad embankment. This necessitated placing it on the other side, and in the course of that work some of the pipe lengths removed from the river were partly covered up. These were uncovered by force account work in preparation for the work of relaying.

PIPE RELAID

A very careful cross-section was again taken of the dredged bottom of the river and the profile plotted to a large scale, showing the exact location and elevation of the two ends of the old pipe on both sides of the river. The contractor first erected a scaffolding on a double row of 4 x 4-in. posts, 5 ft. apart on 12-ft. centers, across the river on the line of the crossing. Sheeted bulkheads were put in at either side from which the water was later pumped to expose the ends of the old pipe to which the submerged section was to be connected. After thoroughly cleaning the old flexible joint pipe both inside and at the bell and spigot ends, it was suspended from the scaffolding to the true profile of the bottom of the river where it was to rest. The joints were then run and calked while the pipe was thus suspended, making it possible to obtain perfect joints.

The cross pieces on the scaffolding were then removed and the six lengths of 10-in. flexible joint pipe suspended therefrom, with the joints all calked, were lowered slowly and evenly by means of ropes at eight points slung around the barrels of the various lengths of pipe and passing through falls. In this manner the pipe was placed on the bottom with practically no motion at the flexible joints. A diver then went down for about an hour and a half for inspection and to properly bed all of the pipe lengths. Everything was found in satisfactory condition.

By the use of the bulkheads it was a relatively simple matter to make the connections at the two ends, place the new 10-in. gate and the 4-in. blowoff and its connections. A special 10-in. bend was placed in the line to take up the grade on the pumping station side where a 10-in. sleeve was also used to close in. There was some slight delay in making these end connections on account of the high stage of water in the river and the consequent difficulty in keeping the pits pumped out.

After the crossing had been completed, the new 10-in. gate was closed tight as well as the 4-in. gate on the blowoff branch and a ½-in. tap was made in the 10-in. pipe beyond the 10 x 4-in. tee and between that tee and the old gate near the freight track. On July 8, 1913, two air pumps were connected to this tap and 40-lb. pressure was maintained for 28 min. after stopping the air pumps without the slightest drop in pressure and without any evidence of leakage. This test, although under a relatively small pressure, was pronounced satisfactory by the inspector from the Department of Public Works of Boston.

Later during that day the crossing was blown out through the 4-in. pipe for 20 min. after opening the new 10-in. gate on the pumping station side of the river, the water running clear after about 5 min. Then, closing the new 10-in. gate and opening the old 10-in. gate near the freight track, it was blown out again from that side for 15 min., the water running clear almost from the start. The 4-in. blowoff gate was then closed and both of the 10-in. gates opened and the crossing put back into regular service. Samples of the water were taken and analyzed both from the crossing and from a tap in a house some distance beyond the pumping station, both analyses showing the water to be up to the metropolitan standard constituting this supply.

The entire cost to the State of removing and replacing the 10-in. flexible joint cast-iron water pipe was as given in the table:

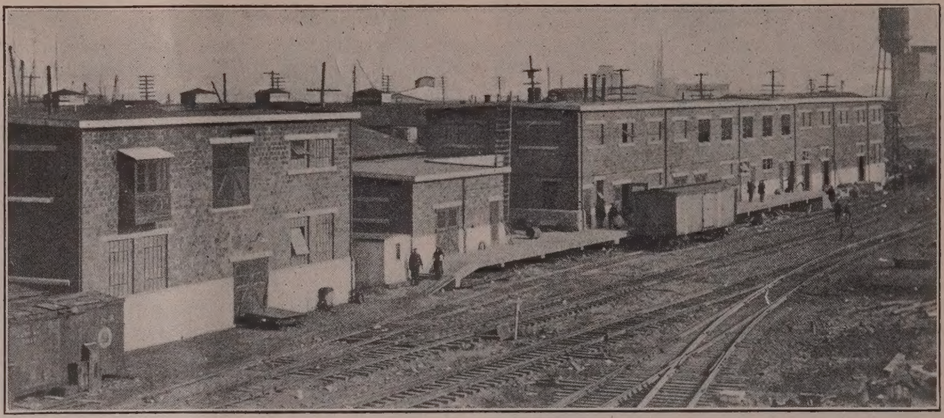
COST OF REMOVING AND REPLACING TEN-INCH FLEXIBLE JOINT MAIN

First cost of removal of pipe by dipper dredge	$75.00
Allowance to dredging contractor for extra excavation at pipe crossing to secure bed desired and to open up at both ends, 232 cu. yd., at 42 cents	97.44
One 10-in. gate, one 4-in. gate, 2 gate boxes	43.48
One 10 x 10 x 4-in. tee, one 10-in. quarter bend, one 10-in. sleeve	53.75
Hauling 10-in. gate and freight on same	2.31
30 ft. of 4-in. pipe, one 4-in. one-eighth bend, one length 10-in. pipe bored out at bell to fit spigot end of the flexible joint pipe	42.60
Crandall Engineering Co. contract price for relaying	790.00
Crandall Engineering Co., extra work, separating the flexible joint pipe lengths, cutting and additional excavation on both banks	46.00
Total cost to State	$1,150.58

The total length of the crossing was approximately 102 ft., making the cost per foot of removal and replacing about $11.28. As the first two and the last items above are chargeable to the removal of the old pipe, the total cost of removal was $218.44, or $2.14 per foot of total crossing length. The total cost of replacing was $932.14, or $9.14 per foot of total crossing length.

This work was under the supervision of X. H. Goodnough, chief engineer of the State Board of Health, with the writer as engineer in charge in the field. The making and calking of the lead joints was under the inspection of Newton L. Hammond, assistant engineer.

MONTHLY MEETINGS FOR ALL MUNICIPAL EMPLOYEES is recommended in a report of the San Diego waterworks superintendent, Herbert R. Fay. The water department has found monthly meetings so beneficial to the individual and so conducive of good to the department that the idea is to be taken up by all officials. A better understanding and better working conditions between departments is sought, to the end that loyalty, efficiency and harmony may prevail, and better results be obtained in city work.



HOLLOW TILE IS USED THROUGHOUT FOR THE EXTERIOR WALLS

Jersey Central Service Buildings at Jersey City Have Several Novel Features

Reinforced-Concrete Substructures Rest on 70-Foot Wooden Piles and, Being Below High Tide, Are Reinforced Against Upward Pressure

ALTHOUGH apparently built along simple lines, the 500-ft. string of one and two-story passenger-car-service buildings of the Central Railroad of New Jersey present features of design not usual in the construction of such commonplace utility buildings. Such features are the driving of wooden piles to a depth of 70 ft., the reinforcing of basement floors and walls against hydraulic pressure, and the construction of a cantilever sidewalk and pipe brackets integral with the floor system. These buildings are just outside of the terminal station at Jersey City, and include one-story toilet and lamp houses, a one-story and basement oil house, and a two-story repair shop, Pullman storehouse, general storehouse and rest house. The rest house and repair shop are steel-frame structures with reinforced-concrete floors. All other buildings have reinforced-concrete frames. The exterior walls are of hollow tile, as shown in the photograph.

FOUNDATION

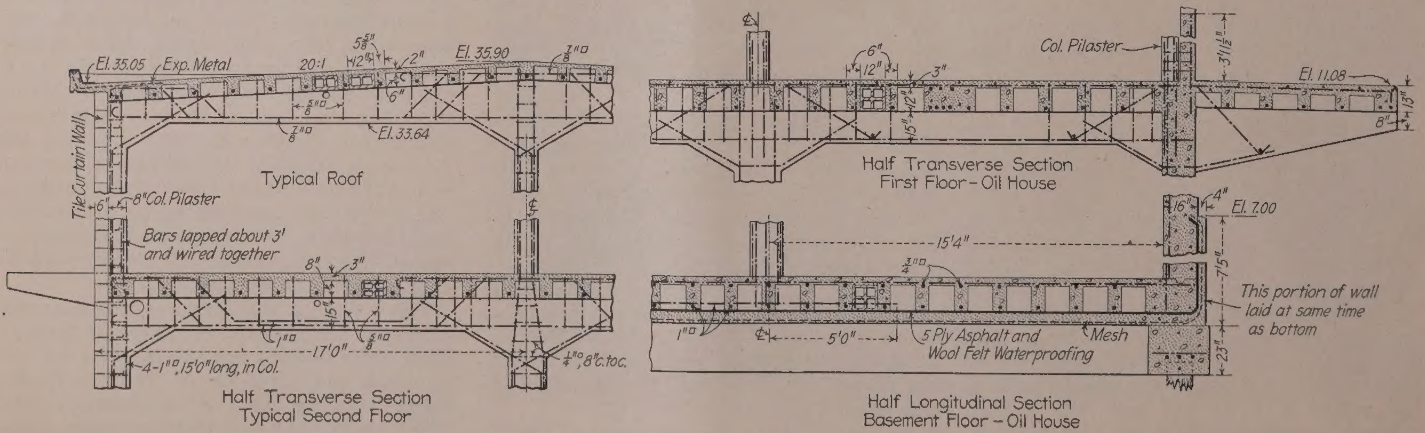
The soil underlying these buildings is composed of silt and fine sand, so that it was deemed necessary to provide piles to support the footings. The yellow-pine piles are driven to an average depth of 70 ft., where bedrock was found, in groups of four, five and six, according to the loading, and capped with reinforced concrete, upon which concrete piers are built. The piers furnish bearings for the columns and for a system of continuous reinforced-concrete girders.

The oil house has a basement story, the floor of which is below mean high water, making it necessary to provide reinforcement in the floor against upward as well as downward pressures. A 6-in. concrete slab, just strong enough to support the dead weight of the floor system, is laid directly on the soil, but bearing on concrete girders; over it is spread asphalt and wool-felt waterproofing. Upon this rests the floor of the beam and hollow-tile type, as shown in one of the drawings. These beams are reinforced both top and bottom, the top reinforcing acting in bending against the water pressure below, and the bottom reinforcing being provided as ordinarily for superimposed loads. This reinforcement is continuous with that of the walls, which are also reinforced for water pressure. The waterproofing in the floor is continued up the side walls to a level about 1 ft. above the ground.

FLOOR SYSTEM

The floors are divided transversely into panels of 16 and 20-ft. widths by continuous girders, running crosswise of the buildings, supported on intermediate and wall columns. The floors are of the beam and hollow-tile type.

Integral with the first-floor girders, on the south side of the buildings are cantilever brackets carrying the sidewalk, or



REINFORCED-CONCRETE DETAILS FOR FOUR LEVELS—NOTE DOUBLE REINFORCEMENT OF BASEMENT FLOOR car platform, which is also of reinforced concrete. On the north side, the second-floor girders are continued outside the building to form brackets for supporting several lines of pipe which run the length of the buildings. To prevent any horizontal thrust being transmitted through these brackets to the building by the expansion of the long lines of pipe, a special device allows play for this movement. Steel channels are bolted to the brackets with the flanges up. To prevent lateral motion of the pipes notches of a proper radius are cut in the flanges of the channels for the reception of the pipes. The pipes rest on steel rollers which lie loose on the web of the channels.

Curtain Walls

In order to lighten the loads on the foundation as much as possible and save material in the continuous girders supporting the walls, vitrified hollow-tile blocks were used to form a 6-in. curtain wall. The tile walls start from the top of an 8-in. concrete wall which is carried around all buildings to a height of 6 ft. The steel or concrete frames of all buildings are totally inside the curtain walls, the curtain walls being carried up from the first-floor level and tied into the columns at frequent intervals with wire binding.

The lintels and sills are made of reinforced concrete. The lines of blocks forming the sides of windows and doorways are filled with concrete and a vertical steel rod is inserted, thus reinforcing the wall to take the spandrel loads. All doors have steel channel jambs, and are of white pine, metal covered, the larger doors being furnished with steel sash. Most of the windows have Fenestra steel sash. All flashing and leaders are of copper. The roof is finished with tar and gravel.

The work was designed and carried on under the general direction of Joseph O. Osgood, chief engineer, and was erected by Westinghouse Church Kerr & Company.

Concrete Scow Has Withstood 4½ Years' Hard Service

APROPOS of the experiences with concrete barges on the Panama Canal, detailed in the Engineering Record of May 29, 1915, page 684, it is worth noting that a concrete barge has been in service on the Welland Canal for four and one-half years and during that time has been subjected to severe service. It is used in canal maintenance work and at times riprap, in loading, has been dropped on its deck from a height of 12 ft.

The scow, which was built in November, 1910, is 80 ft. long, of 24-ft. beam and has sides 7 ft. high. The hull is divided into eight compartments by one longitudinal and three cross bulkheads. There are 2 x 2½-ft. openings through the cross bulkheads. The deck, bottom, sides and bulkheads are 2½ in. thick, reinforced in both directions by ¼-in. round rods on 2-in. centers. Beams 6 in. square on bulkhead lines, reinforced with heavier steel, as required, and braced by reinforced-concrete posts, care for the principal stresses. The concrete is a 1:4 mix, using small gravel.

The boat was designed and built under the supervision of J. L. Weller, then superintending engineer of the Welland Canal, and now engineer-in-charge, Welland Ship Canal.

Illinois Law Requires Licenses for Engineers

Act as Prepared by Western Society of Engineers Provides for Examination and Licensing of Structural Engineers

THE passage of the law requiring structural engineers in Illinois to obtain State licenses, as noted last week on page 59, records the successful outcome of the efforts of the engineers in that State to remedy the situation brought about by the architects' license law, which was so worded that practically every structural engineer practising in Illinois was violating the law, unless working as an employee of an architect. The law as drafted by the legislative committee of the Western Society of Engineers, the essential features of which are abstracted below, was passed by the Legislature after certain minor amendments, made to overcome the opposition of the architects, had been incorporated.

State Board of Examiners

The Governor of the State shall appoint a State board of examiners of structural engineers, to be composed of five members, one of whom shall be a professor in the civil engineering department of the University of Illinois, and the others shall be structural engineers of recognized standing with not less than ten years' practical experience, then practising as structural engineers in the State. The regular term of office shall be four years.

Each applicant for a license shall pay a fee of $20 and present his affidavit that he is 21 years of age or above. He shall sustain a satisfactory examination in the design and construction of buildings and structures according to scientific principles. The examination shall include the strength and properties of various building materials, the principles of theoretical and applied mechanics, and the application of this knowledge to the ordinary requirements of structural engineering in such manner as to fairly and thoroughly test the competency of the applicants.

Each applicant shall show (a) that at the time of the taking effect of this act he was actually engaged in the practice of structural engineering in this State, and did not apply for license under Section 5 of this act, in which case he is entitled to examination without regard to number of years he has practised, or, (b) that within ten years prior to his application he has practised structural engineering in some State or territory of the United States, or in some foreign country for not less than six years, during at least two full years of which he shall have been in responsible charge of work as the principal or assistant, or, (c) that within ten years he has pursued a course of study and training in the theory and practice of structural engineering for the period of not less than six years in the employ or under the supervision of one or more practising structural engineers, during at least two full years of which he has been in charge of work.

Applicants who have graduated from a college or school of engineering considered by the board to be in good standing requiring a course of study not less than four years, during at least thirty weeks in each year, shall be credited to two years upon the six-year period required above. If the result of the examination be satisfactory to a majority of the board under its rules, the secretary shall, upon payment by the applicant of $30, issue a license to practise structural engineering in this State.

Exemption from Examination

Section 5 states that any person who shall by affidavit or other proof show to the satisfaction of the State Board of Examiners that he was a resident of and engaged in the practice of structural engineering in this State on the date of the taking effect of this act, shall be entitled to a license without examination, provided such application shall be made within six months after the taking effect of this act. The secretary of the board shall, upon the payment to him by the applicant of a fee of $50, issue to the person named in said affidavit a license to practise structural engineering. A license, without examination, upon payment of a fee of $50, may be issued to a structural engineer licensed under the laws of any other State or territory of the United States, or any foreign country, provided it appears to the board that in such State or country the license requirements were equal to those prescribed in this State.

No corporation shall be licensed to practise structural engineering, but it shall be lawful for them to furnish to others engineering plans, drawings and specifications for supervision of the construction of buildings and structures, provided the chief executive officer or managing agent in Illinois shall be a structural engineer licensed under this act. It shall be lawful for one or more licensed structural engineers to enter co-partnership with one or more architects licensed under the laws of this State, for the practise of their profession.

Definition of Structural Engineer

Any person engaged in the designing, or supervision of the construction, enlargement or alteration of buildings and structures, as hereinafter defined, or any part thereof, for others, and to be constructed by persons other than himself, is to be regarded as practising structural engineering within the meaning of this act, and shall be held to comply with the same.

Buildings and structures within the meaning of this act shall be construed to mean buildings and structures having as essential features, foundations, columns, girders, trusses, arches and beams, or some of them, and in which safe design and construction require that loads and stresses must be computed and the sizes and strength of parts must be determined by mathematical calculations based on scientific principles and engineering data.

Three Classes Exempt

This act shall not be regarded as applying to draftsmen, students, clerks of work, superintendents and other employees of structural engineers, so long as they work and act under the instructions, control, direction and supervision of their licensed employers; superintendents of construction of buildings and structures employed and paid by the owners, provided they act under the supervision and control of a licensed structural engineer; persons licensed to practise architecture in this State. Nothing contained in this act shall be construed to prevent any person from making plans and specifications for any building or structure that is to be constructed by himself or his employees, and for his own use.

It shall be the duty of the State building commissioner, or the building commissioner of any city, town or village, to issue permits for building construction to any owner or his agents upon filing of a true copy of the plans, drawings and specifications for the construction, and a certificate signed by the licensed structural engineer who executed them certifying under his seal that said plans and drawings are in accordance with the State building code, or the building code of such city, town or village, as the case may be. Every licensed structural engineer in this State shall pay an annual fee of $10.

Revocation and Reinstatement

Any license may be revoked by a four-fifths vote of the State Board of Examiners for gross incompetency; or recklessness in the construction of buildings or other structures; or for fraudulently affixing his seal to plans or specifications; or for any dishonest practice or practices on the part of the order thereof; or for fraud in obtaining his license; or practising without payment of the annual license renewal fee.

The board shall have power to entertain and grant for good cause petitions to vacate its orders revoking licenses and reinstate such petitioner to practise in this State, and to adopt rules and regulations governing the requirement and hearing of such petitions, provided that at least one year shall intervene between the date of the entry of the order revoking a license and the filing of such petitions in cases involving gross incompetency, recklessness, dishonest practices or fraud. Every petitioner shall pay a fee of $10 in advance. A majority vote of the board shall be sufficient to reinstate such petitioners to practice.

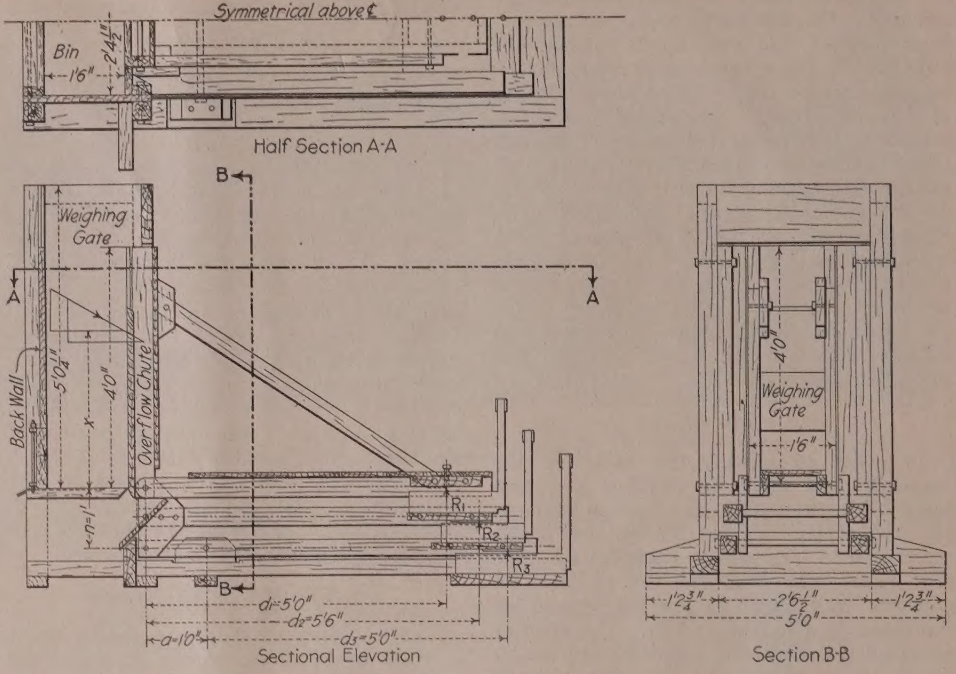
Earth Pressures Determined by Laboratory Apparatus

Prof. J. H. Smith Before American Society for Testing Materials Describes Method for Finding Resultant Force and Reports Tests

A SERIES of experiments has been started in the laboratories of the University of Pittsburgh to determine the position, magnitude and direction of the resultant earth pressure on either vertical or sloping sides of a specially devised model for variable heights from one to four feet. In a paper presented June 24 before the annual meeting of the American Society for Testing Materials, J. H. Smith, professor of civil engineering, University of Pittsburgh, described the apparatus used in these experiments, and reported the results of tests of river sand and gravel on vertical walls. These tests are still in progress and, aside from the statement that the pressure increases with the thickness of the fill, and that moist or wet material gives a higher resultant pressure than dry material, and packed material gives the highest pressure of all conditions tried, with the center of pressure in many cases above the center of the retaining surface, no definite conclusions or comparisons with usual assumptions were given. The following abstract describes the apparatus used and the method of computing the location, direction and intensity of the resultant pressure.

Pressures on Vertical Walls

The special machine shown in the accompanying drawing was designed upon the principle that if the moments of the pressure about three different axes could be determined, the three unknowns could be found. These unknowns were taken to be X, the height of center of pressure above axis 1, V and H, the vertical and horizontal components, respectively, of the resultant pressure R. The other notation used is given on the drawing. Writing the three moment equations about axes 1, 2 and 3 and solving, there is found:



APPARATUS GAGES CENTER, DIRECTION AND AMOUNT OF EARTH PRESSURE

$$H = (R_2 d_2 - R_1 d_1)/n$$
$$V = (R_2 d_2 - R_3 d_3)/a$$
$$X = R_1 d_1 \; n/H$$

When the values of a, d and n used in the apparatus are substituted, these equations reduce to:

$$H = 5 \; (1.1 \; R_2 - R_1)$$
$$V = 5 \; (1.1 \; R_2 - R_3)$$
$$X = 5R_1/H + V/4H$$

The additional term, $V/4H$, in the last equation is introduced because the vertical weighing surface is 3 in. back of the vertical plane through axis 1. By use of the above equations, H, V and X may readily be determined when R_1, R_2 and R_3 have been measured by experiment.

Principle of Apparatus

The figure shows three sectional views of the apparatus as designed and built for practical laboratory tests. The weighing gate, or front retaining surface, has a width of 18 in. and a height, G1, of 4 ft. The weighing gate occupies only the central portion of the front face of the bin, the adjustable ledges at the sides of the gate being attached to the main frame. The weighing gate has two walls, the inner wall forms the retaining surface, while the outer wall is intended to catch any of the filling material which may run over the inner wall, and return it to the space beneath the bin. The height of the inner wall is adjustable by means of removable sections. Therefore a fill of given depth with its angle of repose may be obtained readily by filling the bin until the excess material runs over the inner wall of the gate. The clearance space between the gate and side ledges and bottom is covered with loosely fitting strips of muslin, glued to the inner surface of the bin.

The bin has vertical side and back walls, is 28½ in. wide inside, and 5 ft. high above its floor. The back-wall is made adjustable, so that the thickness of fill between back wall and weighing gate may be varied. This ranges from 6 to 18 in. when the weighing gate is in a vertical position. The back-wall is suspended on an adjustable rod at the top, which allows it to swing outward at the bottom when the fill is to be discharged from the bin, and has removable sections to facilitate the filling of the bin.

As it was not practicable to use knife-edge bearings for axes 1, 2 and 3, 1¼-in. cold rolled shafting with heavy ball-bearings at each end was used. There was some question as to the friction and exact position of the center in the ball bearings used, therefore a special device was constructed for the testing of these bearings. The results showed that the centers of the bearings were quite true, and that they were practically frictionless, even under heavy loads.

The apparatus can easily be modified for measuring pressures on inclined walls. The equations for such cases are worked out in full, but tests have not yet been made.

Mortar Cushion for Granite Block Paving in New York

IN the borough of Manhattan, New York City, the use of a sand cushion for granite blocks has been abandoned, according to information received from Eugene W. Stern, engineer of highways. Under the 1915 specifications a mortar bed is used consisting of one part Portland cement to three parts sand, mixed almost dry. The blocks, it is said, are brought to a proper surface by ramming just as readily as when the old sand cushion was used. The mortar hardens in a few weeks even under traffic.. The great advantage of the mortar bed over the sand cushion, Mr. Stern states, is that surface water leaking through the joints of the blocks does not cause depressions in the surface, which was the case with the sand cushion, and the cost of maintenance is considerably reduced thereby.

State Should Deal Directly with Patentees of Processes and Materials in Public Work

Plan to Prevent Collusion Between Contractor and Patentee Suggests that Highway Departments Assume Payment of Royalties

By S. WHINERY
Consulting Engineer, New York City

THE question of the propriety of using patented materials, devices and processes upon public work has been discussed for a long time; but it has of late attracted renewed attention in connection with the construction of roads and pavements.

There undoubtedly exists in the minds of the public and of public officials a pronounced prejudice against the use of patented articles or processes upon the streets and roads. This prejudice is difficult to account for upon sound principles. So far as it can be analyzed it seems to be mainly based upon the assumption that a patent does, or may, create a monopoly, a word that is particularly obnoxious to people just now. But in addition to this there is prevalent a feeling that many patented articles have, as a rule, little merit and are often exploited under exaggerated claims of value.

PATENTS AND MONOPOLIES

While the courts have quite uniformly held that a patent does not create a monopoly in the true and legal meaning of the word it does confer upon the patentee that kind of a monopoly inherent in the ownership of private property. An invention protected by a patent is as much the private property of the patentee as his real estate or his chattels. Neither his neighbors nor the public may deprive him of such property, nor can State or municipal governments (herein, for brevity, called the State) appropriate or use the patented invention without his consent or by due process of law. But while a patent does not itself constitute a legal monopoly, it may be, and often is, especially in connection with public work, employed by its owner or his agents (who will, in this article, be referred to as the patentee), to create or enforce a true monopoly by extending the protection it offers to materials and methods not covered by it, and in this way to exacting excessive prices and profits. The practices resorted to for this purpose are too well known to need description here.

In ordinary commercial business prejudice against patented articles does not exist to the same extent. The public daily buys thousands of patented articles, presumably for the simple reason that they are better or cheaper than the unpatented articles available. At first thought there would seem to be no sound reason why public officials should not follow the same simple rule with equally satisfactory results. If a patented road or pavement offers better value for the same cost, or equal value for a lower cost than others available, it would seem not only proper but the clear duty of State and municipal officials to secure the benefits offered thereby, provided that these benefits are not offset by possible difficulties and complications connected with its use. Unfortunately, such difficulties and complications are frequently encountered under the methods of procedure now common.

In so far as the prejudice against patents and patented articles is based upon their frequent lack of utility, or upon questionable methods of promotion, including fraudulent or exaggerated representations, it is not without substantial justification. The facts are too well known to need recounting. Experience has taught most of us that only a very small percentage of the patents brought to our attention are of any practical utility, and that even where they possess merit not a few of them are promoted and sold under exaggerated claims or by methods that are at least questionable.

The lesson that such experience clearly teaches is that no patented articles, devices or processes relating to roads and pavements should be adopted or used, except on a very small scale for experimental purposes, until their utility and economy has been well established by experience under conditions similar to those to be met in each individual case. Many careful and prudent officials have learned this lesson, and their disinclination to take up newly patented schemes is the result of wise conservatism rather than of prejudice.

THE CASE OF THE NEW YORK STATE HIGHWAYS

As a text for the discussion of the practical side of the subject, we may consider the action of the State of New York in attempting to regulate the adoption and use upon the State highways of patented articles and processes. In framing the present Highway Law of the State the Legislature obviously sought to apply competition to the solution of the troublesome question of patents. The law provides that:

"In the construction, maintenance and repair of State or county highways no patented material or article or any other material or article shall be specified, contracted for or purchased except under such circumstances that there can be fair and reasonable opportunity for competition, the conditions to secure which shall be prescribed by the Commissioner of Highways."

It will be observed that, contrary to a common impression, this law does not prohibit the use of patented articles or processes. On the contrary, it places them upon an equal footing with unpatented articles, the condition for each being that there shall be opportunity for free and reasonable competition. The law thus skillfully avoids the appearance of discrimination against one class of property; but it shifts the whole responsibility for carrying out its obvious purpose upon the Commissioner of Highways.

That official, in an attempt to comply with the law in the case of one patented pavement, issued the following order:

"Upon the Commissioner of Highways determining that any pavement in any city or village on any county or State highway in the State of New York shall be constructed of ——— pavement, the owners of said patent, within five days thereafter, shall file with the State Highway Department at their office in the city of Albany, New York, a price at which they will deliver said material to contractors in connection with said work to be constructed or improved, said price to be available for any contractor desiring to bid upon said work and the provisions of the offer of said company to be approved by the State Department of Highways."

A similar provision had been inserted earlier in the specifications of a number of cities where it had been desired to admit the use of patented pavements, materials or devices, and the commissioner evidently followed the precedents thus set, adding thereto the provision, not found in most city specifications, that the terms offered by the patentee must be approved by the State Department of Highways. But even with this prudent addition the scheme, as a whole, is very inadequate, and unless supplemented by a number of other provisions, apparently not contemplated, leaves the door wide open for troublesome difficulties and complications.

There is no provision for, and apparently it is not intended that the patentee shall become a legal party to, any contract entered into for work, or that he shall subscribe to or be required to comply with the specifications. He will be under no contract or bond to do so. On the other hand the contractor himself could not fairly, even if he could legally, be held responsible for the quality of a material thus designated and tacitly accepted by the State and supplied by parties over whom he presumably would have no control, since, in theory at least, he must be supposed to have no contractual relation to the patentee.

OPPORTUNITY FOR FAVORED CONTRACTOR

The requirement that the terms submitted by the patentee shall be approved by the highway department implies that that department shall be competent and able to estimate correctly in each case the actual cost of the patented work, and to determine a fair and reasonable royalty for the compensation of the patentee. Otherwise the terms named by the patentee and approved by the department might be excessive and monopolistic and the object of the law defeated. For the patentee might be able to name to a favored contractor such more liberal terms as would enable him to underbid all "outside" competitors and, while naming excessive prices, still be safely the lowest bidder. It has been openly charged in one State that certain favored contractors, through such collusive methods with a patentee, have been able to monopolize large contracts at exorbitant prices, to the serious loss of the State. In another case, where all the facts were obtained and verified, the owner of a patented pavement submitted to the municipal authorities an excessive price at which the patented surface of the pavement would be supplied to all bidders, but he privately made a much lower price to one favored contractor, who was thus able to secure the contract, though his unit prices for all items other than the patented surface were much higher than any of his competitors. Had the "outside" contractors been given the same prices on the patented surface as the favored one the city might have saved many thousands of dollars, for the contract was a very large one.

TERMS OF PROPOSED CONTRACT

To make the plan adopted by the State Commissioner of Highways effective and to safeguard the interests both of the State and the contractor, a comprehensive formal agreement or contract with the patentee would be necessary in the case of each individual road contract, since varying conditions of location, cost of delivery, etc., would affect the fair compensation to the patentee as well as to the contractor. Such a contract with the patentee should embrace:

A. The contractual provisions and specifications of the primary contract in so far as they relate to the patented part of the work. Otherwise the patentee might supply inferior material or work not in accordance with the specifications, in which event the State would apparently have no recourse upon him, and the contractor could not justly be held responsible.

B. A provision that the patentee shall not quote to any prospective bidder prices lower than those publicly announced, and that he shall not accept from any contractor to whom the work may be awarded any lower rate of compensation, either directly or indirectly.

C. The time, place, manner and conditions of deliveries of material by the patentee to the contractor should be provided for and clearly defined.

D. A provision for the adjustment of any differences or disputes that may arise between the contractor and the patentee, in so far, at least, as they may affect the interests of the State.

E. A provision that the patentee shall supply the materials that may be required for the *maintenance* of the road for a stated period of years at a stipulated price, and whenever required.

F. Performance with the terms of the agreement to be secured by a sufficient bond in the usual form.

Other provisions might be necessary to meet special conditions, but even with an adequate contract between the State and the patentee the plan might not work out satisfactorily. Among the three parties in interest there would be opportunities for divided authority and troublesome complications that might result in serious delays to the work, if not in litigation, to the serious detriment of the interests of the State.

STATE SHOULD PAY ROYALTY

These considerations lead to the question: Cannot a better scheme be devised for regulating the use of patents in street and pavement work and controlling the relations between the State, the contractor and the patentee? The writer believes it to be not only possible but comparatively simple and feasible. The plan suggested is not new, but seems not to have been applied heretofore to road and pavement work. Briefly, it is that the State shall agree with the patentee to pay him a stated royalty per unit of the work in which the patent is used, throughout the whole State or municipality, for a period of years. Under such an agreement, wherever the State considered it advisable to utilize patented elements in the proposed work, the character, quality, and name of the materials to be used and the method of their fabrication would be fully set out in the specifications. Bidders would be notified that the State would assume and pay any royalties that might become due upon the patented work specified, or, if legal requirements prevented this, a stated royalty per unit of work must be included in their proposal. But whatever the exact procedure, the royalties should be paid to the patentee by the State and, if necessary, charged against the contractor's account upon the final estimate. A prime object of the plan is to prevent direct dealings, with the possibility of collusive or corrupt arrangements, between contractor and patentee.

ADVANTAGES OF PLAN

The advantages of the general plan here outlined may be briefly stated:

1. It would insure the fair and reasonable opportunity for competition stipulated in the New York law, which is the real end sought after in all like attempted legislative or contractual action.

2. It would prevent, by removing the motive for, collusion and monopolistic agreements between contractor and patentee, which is the most frequent source of crooked and questionable practices in the use of patented roads and pavements.

3. It would prevent divided or uncertain responsibility. It would concentrate the whole responsibility for the character and quality of the work upon one party—the contractor.

4. It would permit the patentee, if he so desired, to bid upon the work upon exactly the same footing as other contractors. It is often the case that the patentee, being the one most interested in the success of his patent, and therefore anxious that the work shall be done in the best manner, prefers to do the whole work himself. For the same reason it is advantageous to the State that he should be permitted to do so. But he would not be able by reason of his patent on one or two items, to exact excessive prices on the unpatented parts of the work.

5. It would be fair and just to the patentee. He is entitled to a reasonable and even liberal compensation for the benefit that his patent may bring to the public, but he is not entitled to use his patent as a club to exact excessive profit on parts of the work not covered by or relating to his patent. The question of the rate or amount of the royalty to be paid to him would be a matter of mutual agreement between himself and the State, either party being free to accept or reject the offers of the other. This is said upon the assumption that a patent is not quasi-public property. If the courts should hold otherwise the State might, by appraisal of value and legal process, regulate the rate of compensation.

6. It would relieve the State and municipal officials of possible trouble and complications arising out of questions or differences between the contractor and the patentee. The arrangement, applying as it would to the whole State for a definite period of time, would simplify and standardize procedure with reference to the patent involved. Contracts under it would be open, daylight transactions, and it would thus tend to remove any ground or pretext for charges of complicity or duplicity on the part of the officials.

7. The great majority of the patents relating to roads and pavements, that are, or are likely to be, useful, relate to or cover processes or special combinations of materials, but not the materials themselves, which are usually procurable in the open market. With the right to use the patent as here proposed the contractor could buy the materials and combine and manipulate them as the specifications require and thus be able to do all the work himself, wholly independent of the patentee, though, if he found it to his interest to do so, he would be free to employ the patentee to do any part of it, but the responsibility to the State for the character and quality of the completed work would remain wholly upon the contractor.

These advantages would seem to commend this general plan to all State and municipal officials. The only objection that can be urged against it is that existing laws and ordinances may not authorize or permit the necessary procedure. If so, they should be suitably amended. Since the plan would be clearly in the interest of the State it should not be difficult to secure such amendments as might be found necessary.

Proposes Definition of the Word "Vitrified"

DEAN Edward Orton, Jr., of the college of engineering of Ohio State University, in a paper entitled "The Legal Interpretation of the Word 'Vitrified' as Applied to Ceramic Products," presented at the annual meeting of the American Society for Testing Materials on June 25, proposed the following definition:

"Where the word 'vitrified' is used in a contract or agreement in describing the properties of a clay product, and is not further defined in the contract, it shall mean that the product shall have attained in the firing process such a degree of compactness that its mean absorption does not exceed 3 per cent of its own initial weight of pure water, when subjected to complete immersion in cold water for 48 hr., or boiling water for 3 hr. Not less than three tests shall be made in determining the mean absorption, and no single test may exceed the mean by more than 0.5 per cent. Neither the possession of the visual properties or appearance of a glass, nor any definite degree of physical strength, hardness, color, or specific gravity shall be implied as an attribute of vitrification."

This definition was referred to the committees on clay products for conference and recommendation, with especial reference to its use in all specifications which contain no definition of the term.

In justification of this definition, Dean Orton stated that color, texture, hardness, strength and specific gravity are all affected in the heat treatment of clay, and that all may to some extent act as rough gages or modes of measuring the progress of vitrification. Color goes through a progressive series of changes, the texture becomes finer and closer, the hardness, the strength and the specific gravity all increase, but exact measures of color, texture, hardness, strength or specific gravity are all impossible or costly, and cannot be correlated exactly with the progress of vitrification. On the other hand it appears that compactness is the one property which most clearly typifies the vitrification process, and that the absorption test makes an excellent and easily applied method of determining it. The absolute degree of compactness of a product is indicated by a single test. By a series of determinations made upon test pieces drawn at different temperatures, the progress of the vitrification process in a burn can be studied equally well by this simple method.

RAILROAD WAGES constituted 45.07 per cent of gross earnings in 1914, as compared with 40.33 per cent in 1905, according to figures recently compiled by the Bureau of Railway Economics.

Severe Tests Show Chicago Municipal Pier to Be Sound in Construction

Attacks on Structural Details Refuted by Committee of Consulting Engineers and by Loading in Excess of Usual Requirements

GROWING out of controversies between the building commissioner of Chicago and the Harbor and Subway Commission were charges that the concrete floors in the city pier would hold up their own weight only, that is, if figured strictly according to the provisions of the building code. Several other charges of violations were made by the building department officials, the most serious being with reference to pile cut-offs above city datum. The more serious charges of instability of the structures, which were described in the Engineering Record of June 19, page 778, have been looked into by boards of reputable consulting engineers, who have in every case given the pier a clean bill of health. The latest accusation, that the floors, floorbeams and piers would not carry designated loads, have been refuted by tests carried out by Robert W. Hunt & Company, June 1 to 9 inclusive. Data on these tests are given because of the remarkably good results obtained.

CEMENT PILED TWENTY SACKS HIGH OVER PILE PIER PRODUCED SETTLEMENT OF 0.17 INCHES ONLY

FLOOR LOAD TESTS

The tests were made for the purpose of determining the amount of deflection and settlement which would occur in the floor, girders and pier foundations under a live load of 750 lb. per square foot, or three times the designed load. The building ordinance requires the equivalent of twice the live plus the dead load or 680 lb. in this case. Cement in bags was uniformly distributed over two 16½ x 20-ft. interior floor panels located in the freight shed. The bags were closely piled up fifteen courses high for the floor and girder tests and twenty courses high for the column footings.

Observations of deflections were taken immediately after each increment of load had been applied and were read by means of a level on scales graduated to twentieths of an inch. These scales were located on each of the six columns, and also on target stakes located at the center point of each girder and floor panel, thus giving a total of fifteen observation stations. Observations were also taken after the full live load of 769.2 lb. per square foot had been carried by the floor panels for 24 hr. The setlements after 24 hr. under load are for columns, as shown in the above table.

SETTLEMENT IN INCHES AFTER LOAD HAD BEEN APPLIED FOR 24 HOURS

Column	Load on	Load off
1	0.050	0.015
3	0.070	0.035
7	0.110	0.085
9	0.115	0.055
13	0.055	0.015
15.	0.030	0.010

The net deflection of girder 2 was 0.030 in., of girder 8, 0.092 in., and of girder 14, 0.057 in. The net deflection of floor 5 was 0.114 in. and that of floor 11 was 0.125 in. To be contrasted with these low figures is the allowable deflection of the girders of 0.300 in., and of the floors, 0.247 in.

In considering the settlement of the piers it is believed by the Harbor and Subway Commission that it was due mostly to end compression of the piles.

PIER TEST

The total load on foundation pier L-12 was 185.6 tons, an average per pile of 46.4 tons. A settlement of only 0.170 in. occurred in 64 hr. The dead load was 117,500 lb. Cement was piled around the column on an area equal to one floor panel, 330 sq. ft., until 1025.7 lb. per square foot had been placed. Of the total amount shown in the photograph only 75 per cent was considered as carried by the column under test.

The foundation piles under the head house support a heavier load per pile (22 tons) than any others on the pier. They have been thoroughly tested for several months with the full load from the 60,000-gal. tanks filled with water. So far no settlement at all has been observed.

PILE CUT-OFF CONTROVERSY

Great stress was laid by the building commissioner on the fact that the piles were not sawed off to a uniform level at least 1 ft. below Chicago datum after being driven. A committee of three engineers, consisting of Col. W. V. Judson, Corps of Engineers, U. S. A., C. W. Cartlidge and R. W. Patterson, made a thorough examination after one-third of the piling had been covered with concrete. The committee reported it did not consider it necessary to recommend any change in the plans in this respect. The comment by the committee on the pile cut-off provision in the building ordinance is as follows:

"When it is considered that this ordinance must provide for safe construction of buildings all over the city and subject to widely varying soil conditions, the wisdom of this provision is evident, but it is not evident that it is necessary, from an engineering standpoint, to conform to this provision if conditions of soil, exposure, etc., are such that piles cut off above the prescribed plans will not be subject to decay in a specific case such as the one we are considering.

"Of course, it is the general rule in such cases that timber will decay unless always dry, or always wet, although protection from air currents (or lack of it) is an important factor.

"The plans for the municipal pier provide that the piles be cut off at heights varying from 9 in. below datum under the head house to from 1 ft. 9 in. to 5 ft. 3 in. above datum under the sheds proper, the bottom of the concrete footings being in all cases 9 in. below the cut-offs. They will be, in all probability, continually moist, and surrounded by moist clay or sand and protected by the inclosing dock walls and the reinforced-concrete floor from circulation of air. The nearness of the water, the permeability of the walls retaining the pier, the sealing of the earth fill by a concrete floor and the circumstance that the fill is largely hydraulic and thus may not be expected to settle away from the pile tops are all conditions favorable to the life of the pile tops when cut off at elevations shown on the plans. It is true that conformance with the building ordinance would have provided insurance against the remote probability of the decay of the tops of these pilings, but on the other hand the cost would have been materially increased and the increase would have been excessive as insurance.

"We must also consider what would be the consequence if some decay of the tops of these pilings should take place. It is the committee's opinion that while this is possible, it is a remote contingency, but if it should occur the damage would be slight and not such as to endanger either the structure as a whole or the lives of its occupants, and would be easily and cheaply repaired.

"The harbor commissioners have abundant precedent for their adoption of this feature and have been more conservative in this respect than the designers of the piers at Portland, Ore., and Boston, where the piles were cut off 19 ft. and 9 ft. above low tide, respectively."

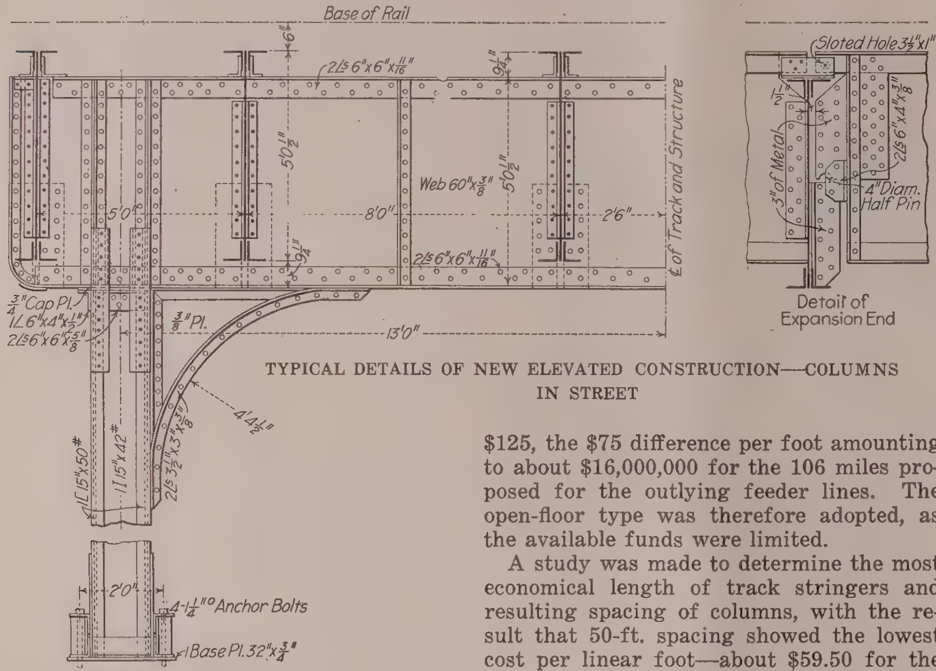
A STRIKING COMPARISON for translating engineering quantities into terms for the layman appears in the Reclamation Record with reference to the 380,260 cu. yd. of masonry placed in the Elephant Butte dam for the year ended Feb. 28. This amount would have covered a 300 x 600-ft. city block 57 ft. deep, or to the height of a five-story building.

Typical and Special Construction Used on Queens Extension to New York Elevated

Reasons for Adoption of Open-Deck Floor, and for Column Spacings—Special Details at Three-Level Crossing of Long Island Railroad

THE NEW Queens extension of the New York Elevated Railway, a part of the dual-system of rapid transit over which there was so much dissension in 1910 and 1911, contains several unusual features of elevated construction, and is now rapidly nearing completion. Elevated trains operated by the Interborough Rapid Transit Company on the Second Avenue line will cross the Queensboro Bridge over the East River. Trains on the Steinway Tunnel line connecting with the present subway in Forty-second Street and the New York Municipal trains from the new Broadway subway will run through the Steinway Tunnel under the East River. This tunnel, which was completed in 1907, has just been opened for traffic. The connections between bridge and tunnel and the new Queens Plaza express station at the eastern end of the Queensboro Bridge are now under construction. Beyond this station the lines branch in the form of a Y, one three-track line turning north to Astoria and the other continuing eastward over the Pennsylvania Railroad yards, along the new Queens Boulevard, and curving to the northwest to Woodside and Corona, the present terminal.

Difficult problems were encountered at the Queens Plaza express station, where many tracks with varying grades and curves had to be provided, and also at the Woodside Station, where the elevated line crosses the Long Island Railroad, which itself is there carried over Roosevelt Avenue as an overhead crossing. Unusual construction is used along the Queens Boulevard, where for architectural appearance a reinforced-concrete arch structure on columns, and concrete-covered steel frame stations, were adopted. The features to be here described include general details of typical steel construction, with reasons for the adoption of the principal sections and dimensions, the typical form of expansion joints used, and the special construction, including heavy cantilever cross girders, adopted in Roosevelt Avenue for the three-level crossing at Woodside station.



TYPICAL DETAILS OF NEW ELEVATED CONSTRUCTION—COLUMNS IN STREET

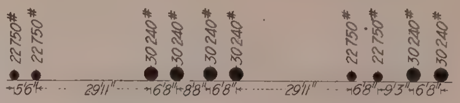
OPEN FLOOR AND DECK GIRDERS

Although solid-floor construction on these elevated lines was preferred, because of the decrease in maintenance cost and in the amount of noise from passing trains, it was estimated that such construction would cost $200 per linear foot and open floor only $125, the $75 difference per foot amounting to about $16,000,000 for the 106 miles proposed for the outlying feeder lines. The open-floor type was therefore adopted, as the available funds were limited.

A study was made to determine the most economical length of track stringers and resulting spacing of columns, with the result that 50-ft. spacing showed the lowest cost per linear foot—about $59.50 for the case of columns spaced 47 ft. 4 in. apart under 6-ft. cross girders, and $52.50 when the columns were spaced 26 ft. transversely. The 50-ft. spacing was therefore adopted, although at street intersections 60 ft. or more often had to be used, and the odd lengths of blocks caused unavoidable variations.

ASSUMED LOADS AND IMPACT

The dead load of track, etc., is assumed at 400 lb. per linear foot in addition to the steel itself. The specified live load for one track is shown in the accompanying diagram. Wind pressure at 30 lb. per square foot from the top of the train to the bottom of the structure, centrifugal force on curves and traction force at 10 per cent of the live load, assuming for a three-track line that only two tracks will be subject to tractive force at the same time in the same direction, have all been provided for.



LIVE LOADING USED IN DESIGN

The impact, in per cent, is given by the formula

$$I = 125 - \sqrt{2000\ L - L^2}/8$$

in which L is the length in feet of loaded track which produces maximum stress. For 50-ft. stringers $I = 86$ per cent; for cross girders in which maximum stress is produced with one track loaded, $L = 100$ and $I = 70$ per cent, while if three tracks are loaded $L = 300$ and $I = 36$ per cent.

The typical construction between the stations consists of six track stringers of the solid-web girder type framing into cross girders supported by two columns, the stringers being spaced 5 ft. apart so that the crossties resting on them are not subjected to bending stress.

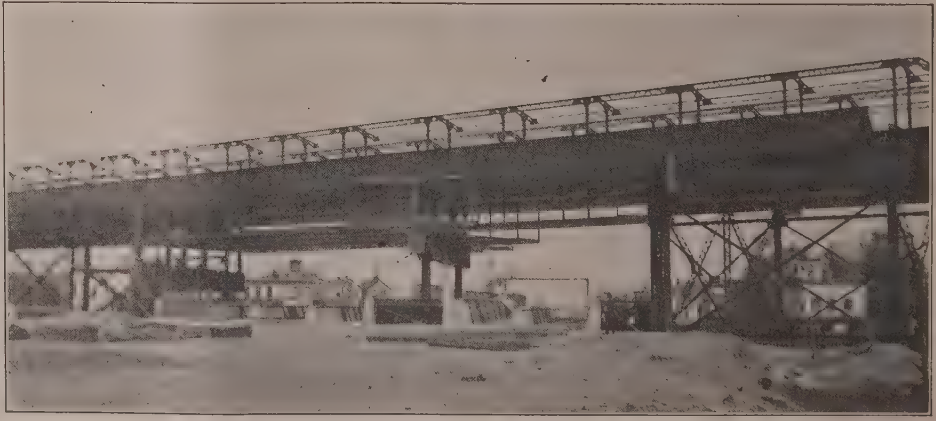
TRANSVERSE SPACING OF COLUMNS

The transverse spacing of the columns was fixed at 26 ft. for columns located in the street. This is the minimum allowable for two lines of trolley tracks below the elevated structure, assuming tracks on 10-ft. centers, and 7 ft. 4 in. clearance to steel. With 13-ft. spacing of tracks on the elevated the center of columns is below the center of outside tracks. The cross girders therefore cantilever about 3 ft. at each end, and are curved and connected to the supporting columns as indicated by the accompanying typical detail drawing. All columns in 100-ft. streets, which have 60-ft. roadways, are spaced 26 ft. apart.

For 80-ft. streets the roadway is 44 ft. wide and there is not enough space between columns and curb for the 16 ft. required to allow two vehicles to pass. Therefore the columns are placed on the sidewalk, 1 ft. 8 in. from the curb, this distance being sufficient to allow for the protection of their bases from passing traffic, and making their spacing 47 ft. 4 in.

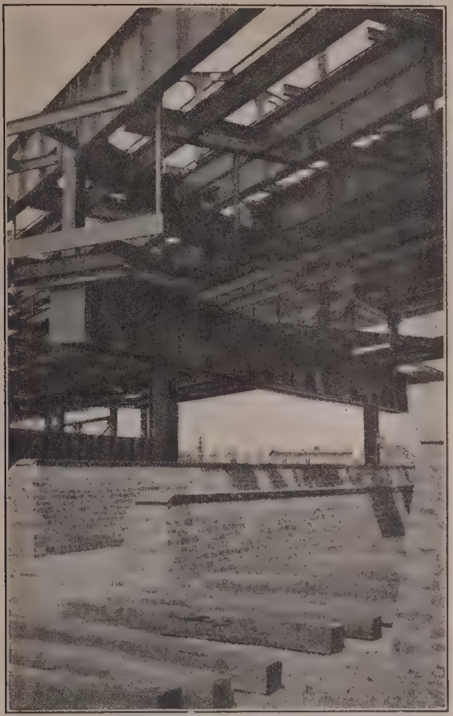
ECONOMIC STRINGER DESIGN

The economic depth of the 50-ft. stringers was found to be 5 ft., and this was



SPECIAL CONSTRUCTION USED AT WOODSIDE ELEVATED STATION

View taken from grade of Long Island six-track crossing over Roosevelt Avenue.



HEAVY DOUBLE-WEB CROSS GIRDER

Carries upper columns and mezzanine floorbeams above Long Island platform below, Woodside Station.

adopted for all spans except those of 70 ft. or more. To avoid cover plates and thicknesses of flange angles exceeding $\frac{7}{8}$ in., which would require the holes to be drilled from the solid, the longer girders were made 6 ft. or $6\frac{1}{2}$ ft. deep.

To prevent excessive deflection for all cases in which the length exceeded twelve times the depth, the usual allowable stress of 20,000 lb. per square inch was reduced by multiplying by the ratio of depth in inches to length in feet. The relatively high unit stress of 20,000 allowed for direct tension and bending fiber stress is justified by the high impact stresses used.

EXPANSION JOINTS

At the stations a through-girder type of construction was used to lower the track level over the mezzanine entrances and reduce the climb from street to platforms to a minimum. Near Woodside Station a typical viaduct tower construction has been used, with bracing in every other bay down to the 14-ft. clearance line above the street for all columns over 30 ft. long. Expansion joints in the stringers were provided at every other bent, provision being made for $1\frac{1}{2}$-in. contraction or expansion from the normal. The typical expansion joint, as shown in the accompanying detail, consists of a 4-in. half-round pin bearing on pin plates on the stringer and sliding on a seat of angles and plates on the cross girder. Small guide angles hold the pin in place and keep the stringer in line. The absence of all seat angles for the erection of stringers, and the riveting of the end connection angles direct to the cross-girder web without fillers, are unique features which it is asserted made a saving of about $1 per linear foot of the structure.

The top flanges of the stringers are braced by the usual type of stringer bracing, which is provided in all spans for the two outside tracks. Similar bracing is provided between the inside track stringers only in the spans containing expansion joints, for the purpose of transferring the tractive force from the center track to the columns without bending the cross girder. Stringer cross frames are provided at intervals varying from $12\frac{1}{2}$ to 20 ft. For the case where long cross girders are used with columns placed at the curb, the outside stringers at a cross frame are connected by deep struts to the columns.

COLUMN DESIGN

In designing the main column sections direct stress and bending stress due to both wind and tractive forces had to be considered. The formula used for direct stress alone was

$$f = 20{,}000/(1 + l^2/8000\, r^2)$$

with a maximum of 14,000. When direct stress and bending stress in one direction only were combined, 20,000 was allowed in the extreme fiber. When bending in both directions was used in the combination, the allowable stress in the extreme fiber was increased to 25,000. The latter value was justified on the ground of the infrequency in the occurrence of such maximum conditions.

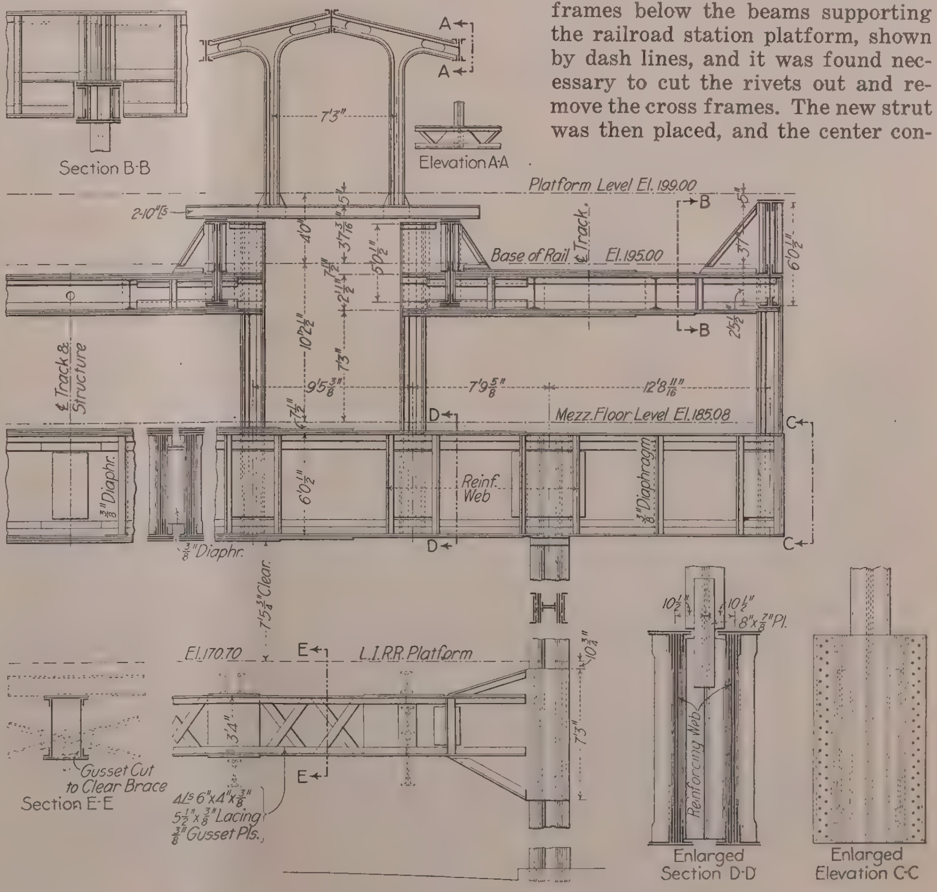
The most effective type of section for columns subjected to bending stresses in both directions is the two-channel and I-beam type, when all sections of the box type are ruled out because of not permitting inspection and painting. This type was adopted, using 15-in. channels, 15-in. I-beams and 15-in. cover plates on the channels where necessary. Some difficulty has developed from the distortion of the I-beams, which come from the rolling mill slightly warped, the two flanges not being exactly parallel. A built I-section has been proposed to replace the rolled I-beam for future designs, although it is less economical.

SPECIAL CONSTRUCTION AT WOODSIDE STATION

Where the elevated railway which is carried along Roosevelt Avenue crosses the Long Island Railroad at Woodside station, it was necessary to design special construction to avoid interference with the existing through-girder spans and columns of the Long Island Railroad overhead crossing. This was accomplished by the use of heavy columns and cross girders, details of which are shown.

This drawing shows a cross-section at the columns which pass directly through the Long Island Railroad station platform. The connections between columns and cross girders are seen to be complicated by the type of column used, which is composed of two interior channels and two heavy outside built I-sections. The double-web cross girder, also seen in one of the photographs, straddles these columns and is riveted directly to the main angles. It is high enough to give sufficient overhead clearance above the platform and yet allow clearance between the mezzanine floor and the longitudinal girders above. The through type of floor construction at the upper level and platform and canopy details are typical of the elevated stations. One of the photographs shows the Woodside station, not yet completed, and the new Long Island Railroad six-track span.

In order to reduce the unsupported length of the columns which pass through the Long Island station platform, a long four-angle strut was used, laced on four sides and connected to the columns with heavy gusset plates as shown. This strut interfered with the existing cross frames below the beams supporting the railroad station platform, shown by dash lines, and it was found necessary to cut the rivets out and remove the cross frames. The new strut was then placed, and the center con-



DETAILS OF SPECIAL CONSTRUCTION AT WOODSIDE STATION

The mezzanine floorbeams and connections are not shown. See photograph.

nection plates of the old cross frames were cut at the corners to clear, as shown on the detail drawing, and the angles threaded through and again riveted up. The manner of connecting the upper built I-section columns to the cross girders by diaphragm plates and angles is shown in the sections and end view of the girder.

The work on these city-built lines has been done under the direction of the engineering staff of the New York Public Service Commission, First District. Alfred Craven is chief engineer, Sverre Dahm principal assistant engineer, and A. I. Raisman senior designing engineer. Maurice E. Griest, assistant designing engineer, has had immediate supervision of the design of the details here described. The steelwork at Woodside was furnished by the American Bridge Company, and the general contractor was the E. E. Smith Contracting Company.

What Kansas Roads Cost

GRAVEL ROADS in Kansas cost from 20 to 60 cents per square yard, averaging about $2,500 per mile for a 10-in. surface 16 ft. wide, where the haul does not exceed 2 miles, according to the latest annual report of W. S. Gearhart, State engineer. Oiled earth roads cost from 10 to 20 cents per square yard, averaging about 15 cents. Waterbound macadam roads vary in cost from 45 to 60 cents per square yard; a waterbound macadam road 16 ft. wide, and with a surface 8 in. thick after rolling, will cost approximately $5,000 per mile under normal conditions. An oiled or bituminous macadam road costs from 10 to 25 cents per square yard more than waterbound macadam. Concrete paving costs from $1 to $1.30 per square yard. Brick roads cost from $1.50 to $2.25 per square yard, averaging about $1.75 where the haul is short. Sand-clay roads cost from $300 to $1,500 per mile for a 12-in. clay surface 16 ft. wide, the average cost being $800 per mile.

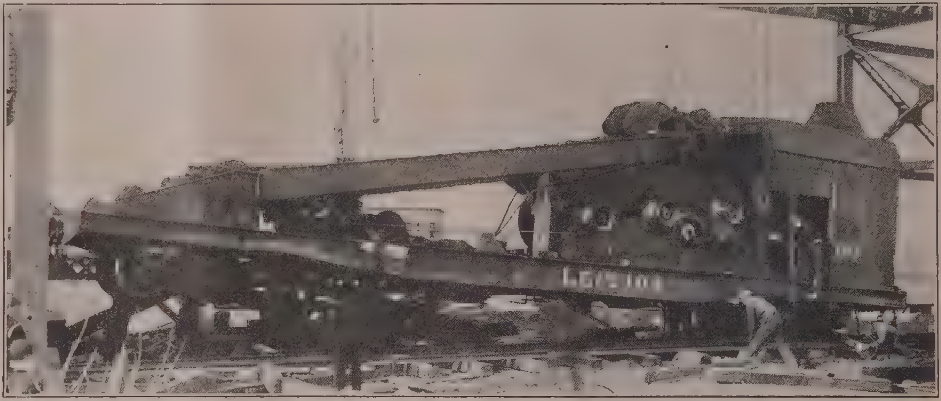
Seventy-Nine-Ton Derrick Car Lowers Itself 50 Feet in Twenty-Five Minutes

Three Sets of Falls Hung from Bents Lead to Hoist—Operator Rides Car and Turns Engine Over Backward with Frictions in During Descent

By A. S. BEALE

Resident Engineer, Lucius Engineering Company, Woodside, Long Island

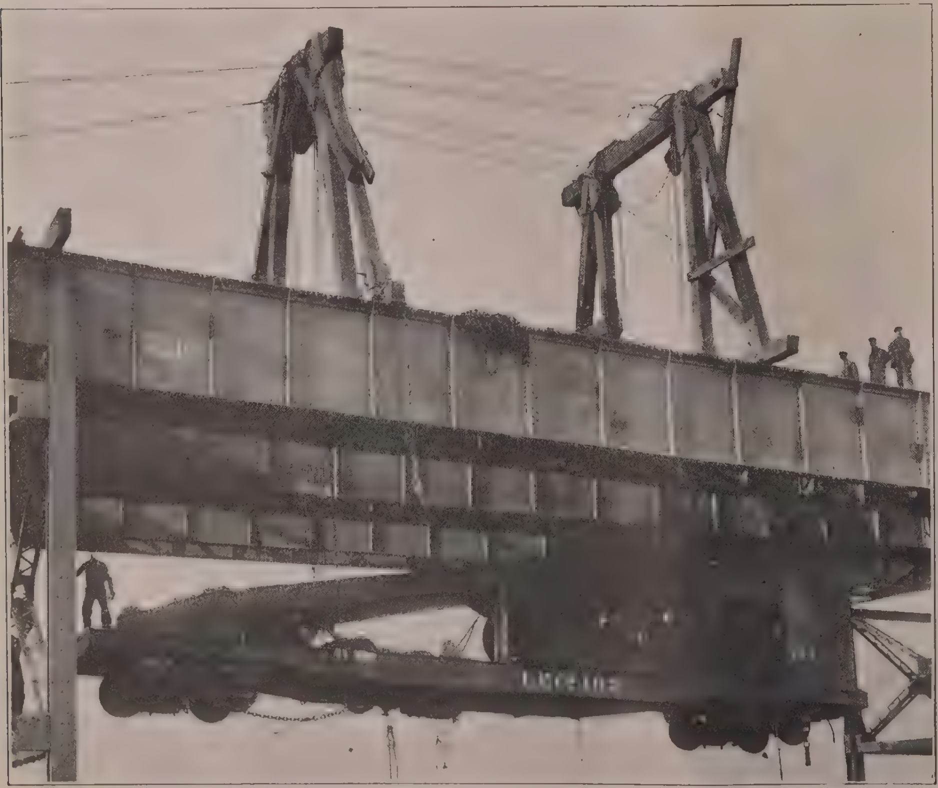
ON COMPLETING the erection of 2 miles of three-track elevated railroad from Corona to Woodside, L. I., a 79-ton derrick car was situated 50 ft. above ground with its usefulness in this position at an end. Physical conditions made impracticable the employment of an inclined plane for the removal of the car, and it was therefore lowered vertically by its own engine, the descent occupying 25 min.



REAR END REACHED GROUND FIRST AS FRONT FALLS CONTAINED MOST PARTS

Notice lead of lines from rear falls to front of car and back to hoist through single blocks. Boom was unshipped for descent.

From its position on the middle or express track the derrick was skidded laterally until it rested directly above the opening between the express track and the westbound local track of the structure, being supported in this position by twelve 8 x 16-in. timbers, six under each truck. A timber gallows-frame was then erected over each end of the car and guyed. From the forward frame one set of falls was attached to the front end of the car, using a sling about the car body. From the rear frame two sets of falls, one on each side of the car, were hung. The front set of falls contained ten parts of ⅞-in. steel hoisting rope rove through two four-sheave blocks and one single block. The rear tackles consisted of eight parts each of ⅞-in. wire rope passed through a pair of triple blocks and a pair of single blocks, leading to the front of the car and thence to the engine, which was a three-drum hoist.



BENTS WERE ERECTED AFTER CAR WAS SLID OVER SPACE BETWEEN GIRDERS

ENGINE TURNS BACKWARD TO LOWER CAR

By throwing in the frictions of all three drums they could, of course, be operated in unison. Although he does not appear in the photographs, the engineer stood at the operating levers, directly in front of the boiler, during the descent. With all three frictions in, the car was picked up and the timbers under it removed so that lowering could begin. The brakes, which had been set while the timbers were taken out, were then released, allowing the drums to pay out in unison, lowering the car and turning the engine over backwards. In this way the descent could be checked or stopped by opening the throttle slightly. It will be seen from the views that during the descent the car left the horizontal. Since the rear falls consisted of eight parts each, while the front set was made up of ten parts, it is apparent that the back end of the car would descend 10 ft. while the front was being lowered 8 ft. To correct this condition the derrick car was halted in mid-descent, and the drums feeding the front falls dogged and held at a standstill while the rear of the car was picked up level. An equal number of parts in all three sets of falls would have permitted the car to remain horizontal during the descent. The reaving of the tackle, however, was regulated according to the loading.

STRESSES IN RIGGING ANALYSED

Of the total load of 79 tons, 31 tons were carried by the front falls. The rear sets of falls carried 24 tons each. The hoisting rope used had a working load of 5.8 tons. When the car was suspended at a standstill, each part of the front falls carried a load of 3.1 tons, and each part of the rear falls a load of 3 tons. Each part was then stressed to approximately 50 per cent of its working load. Additional cable stresses were introduced during the descent of the car by jarring due to the cable slipping on itself as it left the drum. While this occurred but twice, it produced visible drops each time, and caused temporary increases of stress of 100 per cent from impact. Also, the load-distribution on the parts of falls in action is materially different from the load-distribution of the same at rest. Tackle at rest has the load equally divided between each of the various parts. The stresses in a tackle in action pass from a maximum in one part to a minimum in another. In the present case the load was being lowered. Therefore, the standing part, clamped to the becket and farthest from the drum, had the maximum stress. This condition is due to the retarding effect of friction of the sheaves in the blocks, and to the work required in bending the steel rope around the sheaves. The determination of the amount of increased stress in the standing part over that in the lead-line was a matter of estimate, since up to the present nothing on the subject has been published. For the conditions of rigging under consideration the estimate of the increase of stress in the standing part of the forward set of falls was placed at 40 per cent over the stress in the same at rest. Adding, then, to the three-ton stress of the standing part at rest, the impact increase of 100 per cent and the second increase of 40 per cent, there results a maximum stress of 7.2 tons. This was the maximum cable stress in the rigging. It exceeded the working stress by 1.4 tons. This encroachment on the factor of safety, however, was of short duration, and could hardly have been serious.

The gallows-frames used were made up of 12 x 12-in. posts and legs, with 12 x 16-in. caps. After lowering the car, the boom was lowered from the same frame work.

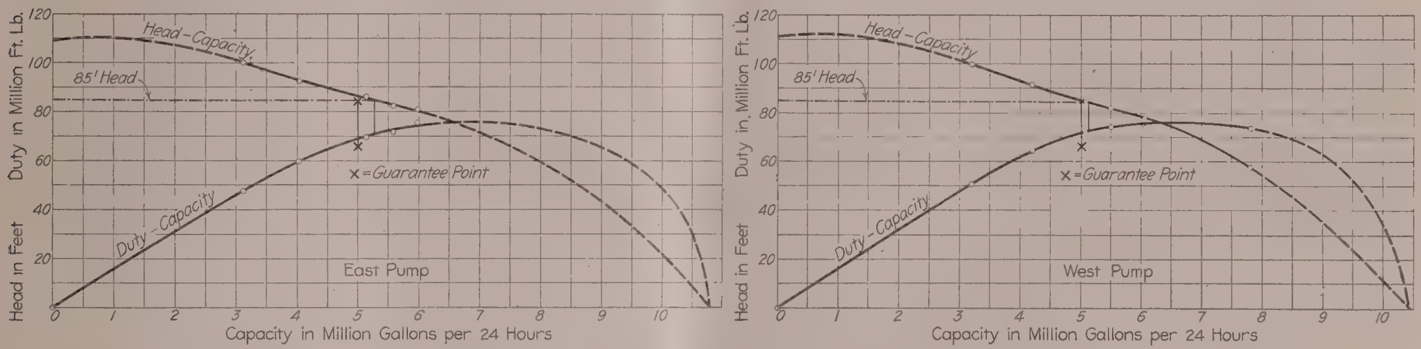
The method of lowering the car was devised by Albert Lucius, and the work was done under the direction of F. B. McEwen of the Lucius Engineering Company of Pittsburgh, erectors for the general contractors, the E. E. Smith Contracting Company of New York City.

High Duty Obtained from Small Booster Pumps

Turbo-Centrifugal Pumps in a Large Central Station Economically Replace Plunger Pumps in Isolated Station

TWO newly installed booster pumps in the Roseland Avenue station, Chicago, exceeded the required duty under test by 8.95 and 5.97 per cent. The pumps boost water to supply the high levels in Washington Heights under a varying suction pressure of from 50 to 60 lb. The pumps replace plunger pumps in a small isolated station and do not require additional labor for their operation. The minimum head of 62 ft. and the maximum head of 85 ft. are the amounts that the suction head has to be boosted, representing the work required. The units are 14-in. Worthington special horizontal turbo-centrifugal pumps direct connected to 115-hp., 2750-r.p.m. Kerr Economy steam turbines. The pumps are of the single-stage, double-suction, screw-impeller type having volute casing. The turbines are of the multi-stage and impulse type with parallel steam flow in the direction of the turbine shaft. The first stage nozzles discharge steam onto the buckets of the first stage wheel, after which further expansion takes place through the second stage nozzles and buckets, and so on through the turbine.

The conditions of the duty guarantee required the accurate determination of the quantity of water pumped, the total head, and the steam consumption, together with a determination of its quality and initial pressure. Each pumping unit was subjected to a separate test of twelve hours' duration.



CHARACTERISTIC AND DUTY CURVES FOR THE BOOSTER PUMPS OF THE ROSELAND AVENUE STATION IN CHICAGO

TESTS DIVIDED INTO RUNS

Each test was divided into runs, one of 4 hours at as near the guaranteed capacity as possible, and four other runs of 2 hours each at capacities above and below the guaranteed capacity, so selected as to give points on a characteristic curve distributed over as great a range as operation conditions would permit. In the case of the west pump, two 1-hr. runs were made in place of one 2-hr. run, in order to get another point on the characteristic curve.

From the characteristic curves and corresponding curves of duty, the capacities and duties at the test head of 85 ft. were obtained. In order to vary the capacity and maintain the same constant during each run, the discharge piping system was isolated from the Washington Heights high-pressure system and the water returned to the low-pressure system through cross-over valves controlling the rate of flow. A pitometer was installed about 1 mile west of the station at a point convenient to the valves mentioned which were manipulated as necessary to get the desired rate of flow as indicated by the pitometer.

The above method of regulating the capacity permitted very constant rates of flow to be maintained, and the temporary isolation of the discharge from the service lines gave the desirable freedom from surges otherwise present.

During the tests the Fisher governor, ordinarily maintaining a constant discharge pressure, was disconnected as otherwise constant conditions of speed, capacity, and head, could not have been maintained.

MEASURING QUANTITY PUMPED

As the suction pressure of the booster pumps was fixed by its maintenance in the low-pressure distributing system of the city, and did not come within the range of 50 to 60 lb., no attempt was made to keep the discharge pressure of the booster pumps at 200 ft. as specified. The quantity of water pumped during the tests was measured by a 30-in. Venturi meter which, with its mercury manometer and combined indicating, recording and integrating instrument, is a part of the permanent equipment of the pumping station. Since the amount of water discharged from each pump was considerably below the normal capacity of the meter the mercury manometer furnished with the meter showed only about 1 in. of deflection at rated capacity of each pump. In order to obtain more legible readings, a temporary inverted water manometer, giving 12.58 times as much deflection as the mercury manometer, was employed for determining the rates of discharge that were used in computing the duty.

Inasmuch as the suction pressure is subject to pulsations due to the low pressure pumps which would cause corresponding pulsations to be set up in both the suction and discharge mercury columns if connected independently thereby causing difficulty in reading, it was decided by the experts conducting the test to lead the suction and discharge connections to a common mercury U-tube, thereby neutralizing the pulsations.

CONCLUSIONS

The test of the west pump, when pumping against the specified head of 85 ft. showed an official duty of 73,000,000 ft.-lb. per 1000 lb. of steam corrected to an initial pressure of 170 lb. gage and 98 per cent dryness and a capacity of 5,120,000 gal. per 24 hours, thereby exceeding the guaranteed performance of 8.95 per cent in duty and 2.40 per cent in capacity.

The east pump under similar conditions showed a duty of 71,000,000 ft.-lb. and a capacity of 5,280,000 gal. per 24 hours, thereby exceeding the guaranteed performance by 5.97 per cent in duty and 5.60 per cent in capacity.

The tests were carried out by W. A. Nelson, representing the city, by R. W. Allerton, representing W. A. Pope, contractor, and by C. J. Bacon. The pumps were installed under the general direction of John Ericson, city engineer, and H. S. Baker, assistant city engineer. Henry W. Allen is mechanical engineer of the water department in charge of pumping stations.

British Engineers Advised as to Uniform Charges

Institution of Civil Engineers Formulates General Policy to Govern Fees for Professional Services

CHARGES for professional engineering services in Great Britain, involving design and superintendence of construction, ordinarily amount to 5 per cent of the cost of the work, but the diversity of conditions involved in different undertakings makes impossible any rigid standard. Nevertheless the Institution of Civil Engineers, through its council, has endeavored to put into effect a plan whereby its members will adopt a more or less uniform policy as to charges. To this end it has issued a statement, the substance of which is given below:

In the case of undertakings where the services rendered by the engineer are large relatively to the extent and cost of the work, or in the case of undertakings involving a considerable amount of intricate and detail work, the commission of 5 per cent may be increased. On the other hand, in the case of exceptionally large undertakings, the commission may be reduced by agreement.

The preparation of bills of quantities, payments to resident engineers and inspectors, and also personal traveling expenses are matters for arrangement, depending upon the nature of the work and the circumstances under which it is carried out, and may be included or not included in the engineer's remuneration according to the extent and difficulty of the works and the amount of detail work involved in the preparation of the plans, drawings, specifications and bills of quantities, and also the amount of superintendence by the engineer's staff necessitated by the character of the work.

Where the works are designed in sufficient detail to enable a contract for their execution to be made or to enable the local government board to hold an inquiry into the propriety of allowing an authority to borrow money for the purposes of the works, but where the carrying out of such works is deferred indefinitely or abandoned, the fee for services up to this stage is one-half of the ordinary commission.

The council is advised that plans and specifications prepared by an engineer belong, as chattels, to the client, after payment of the agreed fees; but the copyright in all original matter contained in such plans and specifications remains vested in the engineer. Neither the client nor any other person is entitled to multiply copies of plans and specifications so far as the original matter therein contained is concerned, and, further, if such original matter has "an artistic character or design" the plans can only be used for the purpose of the particular structure for which they were prepared by the engineer, or for such other purpose as he may authorize. Original matter in specifications is defined by counsel to be a composition or arrangement of the author—something which has grown up in his mind, and would, if applied to patent rights, be called invention.

Charges for reports on engineering proposals must necessarily be largely dependent upon the extent of the inquiry and research upon which the reports are based, and upon the professional standing of the engineer employed, and cannot, therefore, be dealt with in any scale of fees.

Remuneration for services in preparing for and giving evidence before Parliamentary committees or other tribunals generally consists of a preliminary fee, and a charge per diem while engaged upon the preparatory work and during the hearing of the inquiry, as well as all out-of-pocket expenses.

Handling Hydraulic Fill on Piute Dam

Joseph Jenson, Consulting Engineer, Gives Kinks in Trestle Construction and Unit Costs on 95-Foot Earth Dam in Utah

STEEL-LINED hydraulic flumes on steel trestles and special tangent construction on curves were features in the building of the hydraulic fill earth dam for the Piute irrigation dam on the Sevier River near Marysville, Utah. The manner in which hydraulic nozzles were used for excavation and pumps for removing spoil in the core trench was described in the Engineering Record of Nov. 8, 1913, page 522. A full report on the construction and cost of the project has recently been made to W. D. Beers, State engineer, by Joseph Jenson, consulting engineer. From the report the following information has been taken:

Hydraulicking in the material for this 95-ft. earth dam required four seasons, the work being finally completed in 1914. Before the hydraulicking was started, the upstream toe was built up 53 ft. by hauling with wagons and dump boards in the usual manner from a deposit of fine material lying in a ravine too low to be available for sluicing.

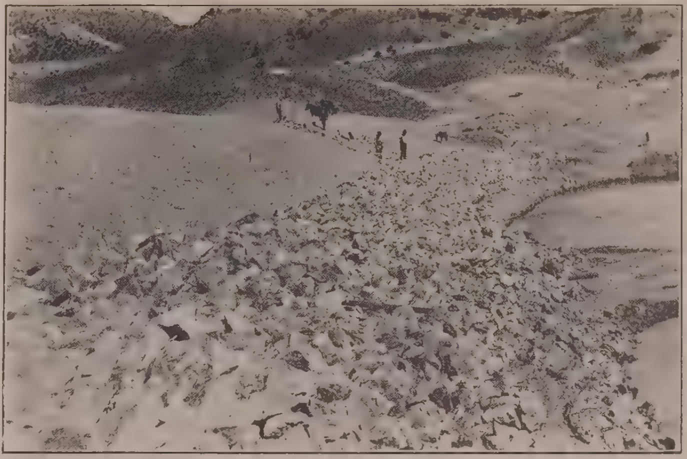
HANGERS HOLD BOX BOTTOMS TO SIDES

For hydraulicking a high trestle was built extending from near the solid rock ledge on the west with an upgrade of 4 per cent, to the hill on the east side. This first trestle was built midway between the axis of the dam and the downstream toe, that is, 100 ft. inside the dam area. Branch trestles were built laterally from the main line, at first all extending outward. On these trestles was built a steel-lined sluice box 15 in. wide and 12 in. deep inside. The steel lining consisted of a bottom plate ¼ in. x. 15 in. x 14 ft., the side plates were ¼ in. x. 10 in. x 14 ft., all being hard steel containing 0.4 to 0.5 per cent carbon. Special nails with conical heads were used to fit the countersunk plate holes. The box, itself, was made up out of 2 x 12-in. plank. The boxes were made of Oregon fir in 14-ft. lengths. The butt joints between the sections were lapped by steel plates, and so arranged that each section could be handled as a unit without knocking it down. It was soon found that this scheme of sluice box construction was not entirely satisfactory. In spite of very close and heavy nailing, the heavy, rough material rolling on the bottom of the sluice boxes would, in a comparatively short time, pound the bottoms loose from the side boards, which resulted in a large percentage of loss of sluicing water, and a more than proportionate loss of mov-

PIUTE HYDRAULIC FILL DAM IS 95 FEET HIGH

BOULDERS IN SLUICE BANK HINDER WORK OF GIANT

GIANTS DO BEST WORK WHEN SET 50 TO 150 FEET FROM BANK



UPSTREAM TOE OF DAM WAS HEAVILY RIPRAPPED WITH STONE

ing power. This condition was overcome by placing a halter on the box.

As the fill proceeded, all side and cross-braces were taken off and only the posts and caps of the trestle remained standing in the fill. After the fill was brought up to the top of the first line of trestles, this sluice box line was laid out along the center of the dam, and the form of trestle and sluice box construction, shown in the drawing, was used. The lifts, by stages, were from 10 to 12 ft. This was found to be more economical both in timber used and time required for construction than the higher and more complicated trestle construction.

Handling the Retaining Banks

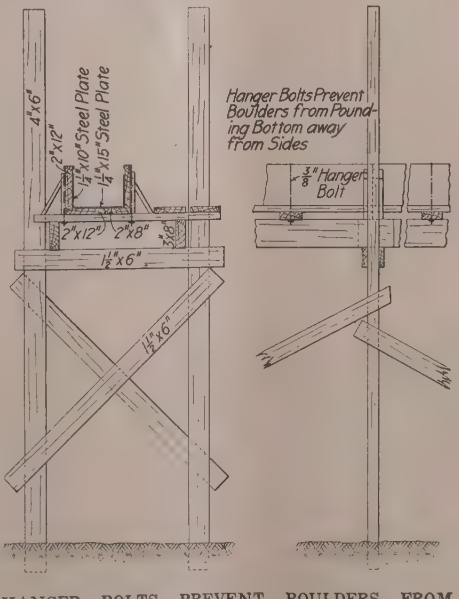
When the sluicing operations began, a bank of dirt had been scraped up along the lower toe of the dam about 6 ft. high. As the fill proceeded this bank was kept built up about 4 ft. higher than the surface of the settling pond. During the first year of sluicing operations, no dry material was hauled in to keep up this bank. The wet material sluiced in was scraped in from the inside of the dam area to form the lower slope. As already stated, a high bank had already been hauled in forming the upper toe, so that nothing was done during the first season on this slope. The material on the lower toe was so deposited as to form the regular 1 on 2 slope, but as weight was added, the saturated and plastic material forming the dam squashed out so as to make a steeper slope than was contemplated, in the final slope up to the 45 ft. elevation, at the end of the season's run. This added width was taken advantage of later to build the dam up to the 95 ft. elevation instead of to only 90 ft., as originally designed, which step increased the capacity of the reservoir from 78,400 to 92,600 acre-feet.

During the second season, and until the completion of the dam, a heavy dry bank was hauled in along each edge and the regular slope maintained. In September, 1913, all the material available for sluicing on the east side, whence all material up to that time for the fill had been obtained, was exhausted. A deposit of first class material was found to exist just back of the high ledges on the west side. This was obtainable by cutting through several reefs of solid rock, the cuts varying from 5 to 21 ft. in depth, and by building high trestles between. The last 5 ft. of fill forming the crest of the dam was hauled in dry.

The flow of water used for sluicing varied from 4 to 6 cu. ft. per second, depending on the elevation and consequent pressure at the giant nozzle. The giants used were No. 1 Hendy giants with 4-in. diameter nozzle tips. Best results were obtained when the sluice bank was distant from the giant setting from 50 to 150 ft. At nearer settings it was found more difficult to regulate the amount of earth carried down to the sluice flume in such a manner as to utilize the full carrying power of the water, and to keep the sluice boxes from clogging. At greater distances the eroding power of the jet was lessened, and the system, therefore, operated under light load. It was found advantageous to keep a boosting jet near the head of the sluice boxes. This was obtained by attaching a length of 3½-in. fire hose to the pipe line back of the giant, with a fire nozzle attached and fastened immediately over the sluice box, with the jet directed slightly downward and along the direction of the sluice box. This was found particularly efficient in giving the very coarse material a rolling rather than a sliding motion along the sluice box bottom. By this device it was possible to handle rocks weighing 50 to 60 lb. without difficulty.

Tangents Better than a Smooth Curve

Another item which proved rather interesting was the manner in which turns in the sluice box should be made. It was at first assumed that these turns ought to consist of long smooth curves. These, however, gave considerable trouble, even when the grade was made somewhat steeper, by the rougher material slowing up and thereby causing the boxes to clog. Careful observation showed that this was due to the added friction caused by pressure against the side of the box. It was also observed that when this rough material was allowed to impinge against a vertical surface set obliquely to the direction of the motion that the larger rocks would rebound from the surface, then return to the side with a series of decreasing impacts and velocities before they finally assumed their altered direction with an accelerating motion. When the turns were made with a series of tangents 14 ft. long, each one making an angle of about 150 deg., i. e., a 30 deg. offset with the preceding, the clogging tendencies were almost entirely overcome.



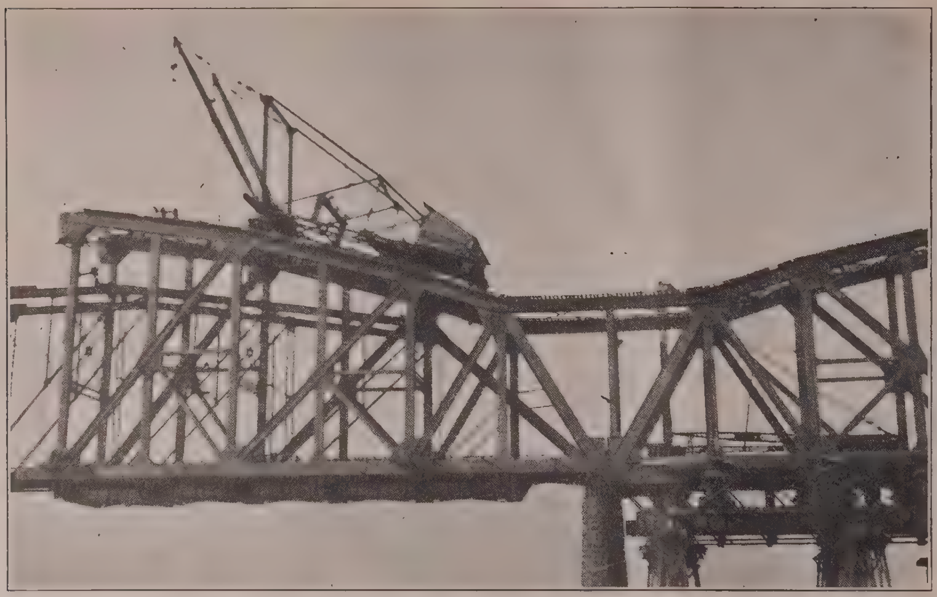
HANGER BOLTS PREVENT BOULDERS FROM POUNDING BOTTOM AWAY FROM SIDES

The sluice banks on the east side contained a large amount of rocks and boulders. These would eventually cover the borrow pit area to such an extent that it would become impossible to penetrate the surface with the stream from the giant. It was, therefore, necessary to keep a force of men and teams at work clearing away these rocks and boulders which were dumped on the downstream slope of the dam and were later hand laid, thus forming a very efficient riprap and serving as a protection of this slope against weather erosion as well as from the tramping of sheep and cattle.

Costs

The 257,600 cu. yd. of hydraulic fill cost 20.9 cents per yard, estimating 100 per cent depreciation of plant. This figure would be reduced to 18.7 cents if a depreciation of 50 per cent were charged off. The dry fill of 186,500 cu. yd. cost 47.8 cents per yard. Riprap on the upstream slope, 8540 cu. yd., cost $1.905 per yard, and the 3177 cu. yd. on the downstream slope cost 72.9 cents per yard. The total cost of the dam and contiguous work was $322,311.96. The unit cost of the total fill, 444,100 cu. yd., based on 50 per cent depreciation, amounted to 30.9 cents per yard.

Sand-Clay Road Maintenance in Colorado costs from $50 to $100 per mile per year. The same figures hold for gravel roads. Dirt roads cost $20 per mile per year.



NEW PIER GRILLAGE PLACED—CANTILEVER ERECTION OF 525-FT. SPAN

New stringers used on falsework to support floor and temporary anchor span by blocking.

Longest Riveted Simple Trusses Erected Around Old Bridge by Cantilever Method

Half Spans from Back Channel Used as Anchors for 525-Foot Main Channel Spans During Reconstruction of Ohio Connecting Bridge

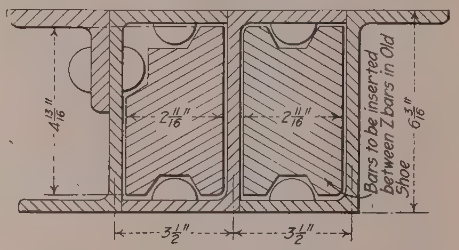
THE ERECTION of the longest riveted simple truss span in the country has recently been completed at Pittsburgh by a unique cantilever method involving the use of anchor arms temporarily adapted from another span used in the same crossing. The Ohio connecting bridge of the Pennsylvania Lines West of Pittsburgh over the Ohio River, an old single-track structure about 4545 ft. long, built in 1890, is being replaced by a modern double-track bridge supported on the same piers, which were originally built wide enough for this purpose. The original single-track crossing consisted of one span 525 ft. long over the main channel and a series of eleven deck truss spans, each about 175 ft. long, across Brunot's Island, and a 416-ft. span over the back channel. The long steel single-track viaduct approaches consist of about 636 ft. on a curve and 660 ft. on tangent and one 140-ft. deck truss span at one end and two deck truss spans at the other end.

The reconstruction work included the replacement, practically without interruption of traffic, of the old 525-ft. single-track span, which was about 65 ft. deep at the center, by the double-track riveted truss span shown in the accompanying elevation, about 91 ft. deep at the center and 50 ft. at the ends. The cantilever erection of this span was accomplished by using half trusses from the 416-ft. back-channel span. The approach viaduct was also changed to a double-track structure, and the grade decreased from 0.56 per cent to 0.3 per cent. The 140-ft. span shown by dash lines on the elevation was originally designed to support two tracks, one track to Pittsburgh branching off from the main line. It was first shifted to one side while the falsework and anchor span were used for erecting the 525-ft. span, and then replaced in its new position on the piers.

The deck trusses across Brunot's Island are replaced on the same piers by double-track triangular trusses of the type shown on the drawing. The old 416-ft. pin-connected Pettit trusses, which were 60 ft. deep, are being replaced by the riveted trusses shown in the diagram, 75 ft. deep at the center, after they have served as temporary anchor spans as above mentioned. The deck truss spans at the end, shown by dash lines, have been retained in the new structure, as they originally supported two tracks.

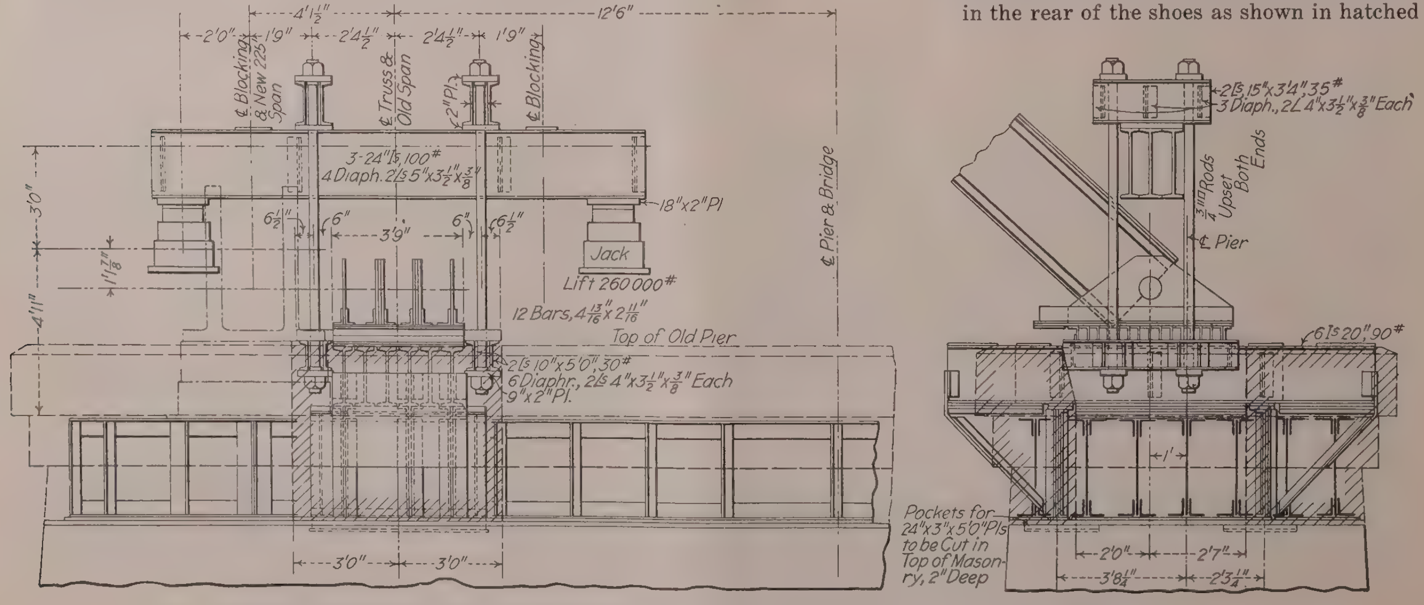
CUTTING DOWN OLD PIERS UNDER TRAFFIC

One of the most difficult problems was the removal of several courses of the masonry from the tops of the old piers to allow the placing of seven heavy plate girders acting as pier grillages for the purpose of distributing the heavy loads over the piers and making room for much deeper and heavier shoes than were used in the old structure. One of the accompanying drawings shows the details of the scheme adopted. Since traffic had to be maintained, it was necessary to use a method which would insure a minimum interruption of trains while the old trusses were suspended. This was accomplished by the use of outside temporary girder supports resting on the piers and carrying six 20-in. I-beams as shown.

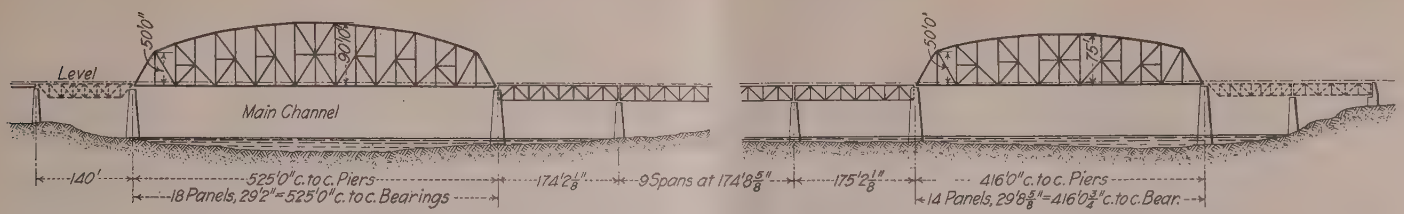


SPECIAL BARS TO SUPPORT OLD SHOES

The order of operations for both the piers was the same. First, the old shoe plates, grillage and rollers were burned through with a flame, to reduce the width of the old shoes to 3 ft. 9 in. The masonry of the pier was then removed for 3 ft. on each side of the center line of the trusses in front and in the rear of the shoes as shown in hatched



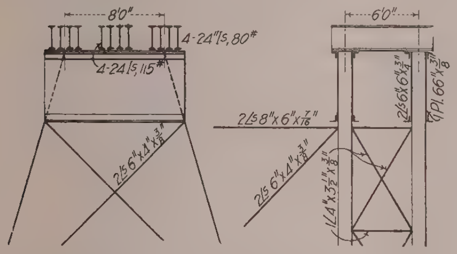
DETAILS OF SCHEME USED TO CUT DOWN TOP OF MASONRY PIER AND PLACE GIRDER GRILLAGE



OHIO CONNECTING BRIDGE OF THE PENNSYLVANIA LINES WEST OF PITTSBURGH—BRUNOT'S ISLAND IN CENTER

outline to allow the two above-mentioned supporting girders to be placed. These girders rest on the 24 x 3-in. bearing plates grouted into the pier as noted. Enough of the top course of masonry was taken out to permit the double-channel beam to be inserted. These 10-in. channel beams support twelve special bars, 4 13/16 by 2 11/16 in. in size, inserted in the old Z-bar grillage. The details of these bars, which are shaped to clear the rivet heads, are given on the accompanying large-scale drawing.

Jacking girders of three 24-in. I-beams 14 ft. long were then placed and the 3¼-in. square rods erected. Traffic was stopped and the span load lifted from the shoe by the two jacks. The top course of masonry immediately under the shoe was removed and six 20-in. I-beams were placed under it and on top of the supporting girders, and connected to the brackets as shown. The span was then jacked down until the shoes rested on these beams and girders, when traffic was allowed to pass.



MATERIAL AT TOP OF TEMPORARY BENTS

The jacks and jacking girders were then removed, and the masonry was cut down to the final level below the bottom of the new pier girders. A concrete fill was poured on top of the old course of masonry to give the proper level for the plates under the pier girders. The four inside pier girders were placed in position, one at a time, and the I-beams supporting the shoes were wedged up from the pier girders until the load was released from the outside girders and brackets, which were then removed. The remainder of the pier girders were then set. During the removal of the masonry courses, the end stringers and the temporary girders for the adjacent span were followed up with blocking to take care of the traffic.

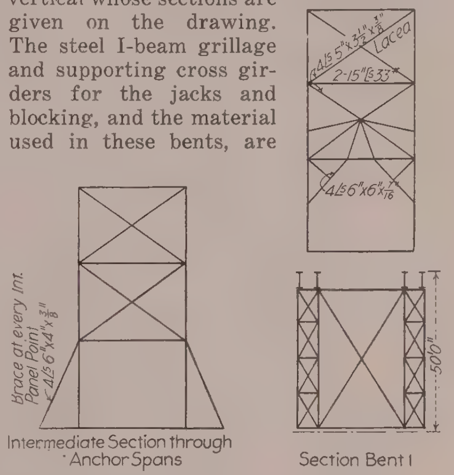
The general scheme used in the erection of the heavy main channel span is illustrated. Partly owing to the necessity for preserving a clear channel during erection and hence for adopting the cantilever method, and partly owing to the desire for rigidity and stiffness in the new structure, these trusses were designed of stiff members with riveted joints, making them the longest of this type yet constructed. The novel method of providing anchor spans by the use of the new material for the 416-ft. back-channel span with the addition of a few members to support platforms weighted down by stringers, floorbeams and steel rails to develop the desired resistance to uplift is indicated by the drawing.

The anchor spans were erected on timber falsework, using the special supporting girders for the end shoes as shown in one of the accompanying photographs, which also indicates the method of blocking up under the panel points and under the floor on the new steel stringers, temporarily used below the trusses. The new main trusses were erected by the large two-boom travelers shown, the material being delivered on barges in the river below and hoisted into place. The heavy built-up erection ties of twelve plates and two angles carried the traveler loads on the blocking seen in the photograph, being supported by temporary posts above the piers. The erection and wind stresses in some of the members of the anchor spans are very high; in the end post the total is 3,000,000 lb., which is about the same as its total normal design stress.

BRACING AND STEEL BENTS

The lower chords of the anchor trusses could not be braced laterally on the inside without interference with the floor and traffic. The outside horizontal triangular trusses shown in the plan view were therefore designed to keep these chords in line. Diagonal braces to the vertical posts, as shown in the cross-section, were used outside of the anchor trusses to support the horizontal trusses. As the new 416-ft. trusses used in these anchor spans are spaced 32 ft. apart, and the main 525-ft. trusses are 33 ft. 3 in. apart, the upper diagonal bracing and the swaybracing had to be lengthened for this erection condition by the addition of ½-in. lateral plates.

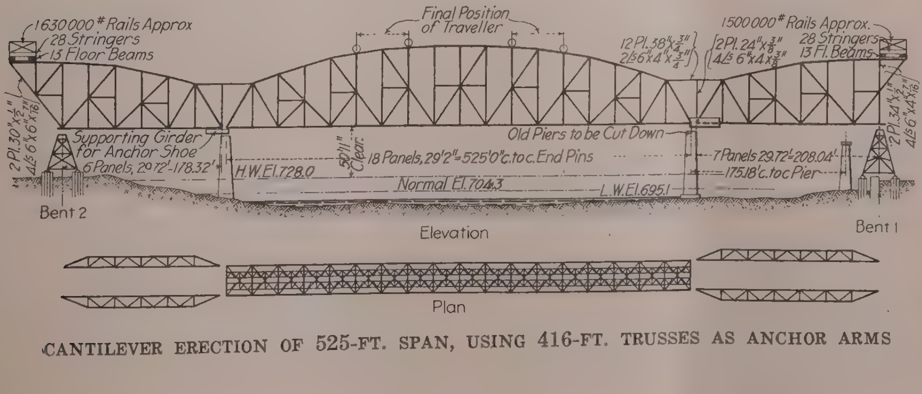
The cross-sections at the steel erection bents 1 and 2 given on the drawing indicate the erection material which had to be supplied for bracing at these points, all members being of the stiff latticed type. It is seen that one bent was placed six panels from the left main pier, while the other is seven panels from the right main pier to avoid interference with the existing piers shown. The only added truss members required were the right end diagonal and half vertical whose sections are given on the drawing. The steel I-beam grillage and supporting cross girders for the jacks and blocking, and the material used in these bents, are shown on the details. The bents were supported on piles capped by steel I-beam grillages.



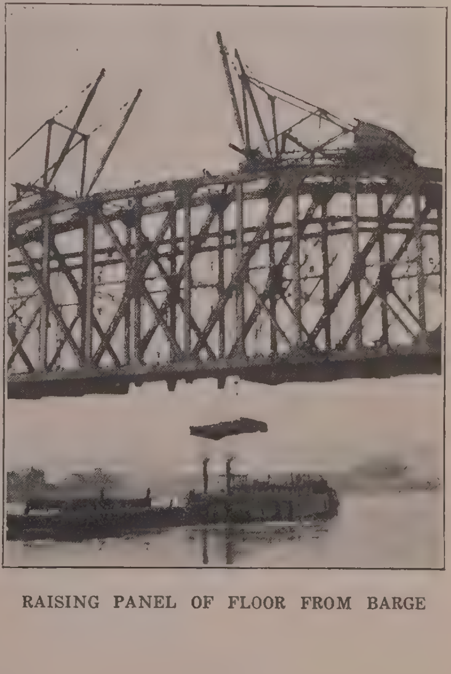
SECTIONS SHOWING BRACING OF TEMPORARY ANCHOR SPAN AND BENT 1

RAPID PLACING OF NEW FLOOR

The new floor system was riveted up on barges and raised into a position below the old floor and temporarily supported by long hanger plates below the main panel points. One of the photographs shows a panel being raised from the barge into position below the truss. The drawing on page 84 shows



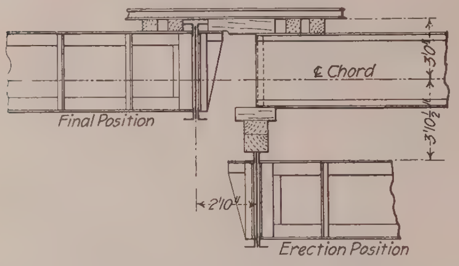
CANTILEVER ERECTION OF 525-FT. SPAN, USING 416-FT. TRUSSES AS ANCHOR ARMS



RAISING PANEL OF FLOOR FROM BARGE

that two floorbeams are used at each panel point, and indicates the scheme adopted for the erection of the floor. It is seen that the new floor panels were first erected in a position about 6 ft. below their final position in the completed bridge. This was for the purpose of supporting the old trusses and floor before their removal. The old trusses were spaced 25 ft. apart and the new trusses 33 ft. 3 in. apart, the two interior lines of new stringers being the same distance apart as the two lines of old stringers. It was therefore possible to block up the old stringers on the new. Since the old trusses consisted of twenty panels at 26 ft. 1¾ in. each the panel points did not match, and it was necessary to cut the old stringers to permit raising the new panels one at a time.

After the new floor system was placed in its temporary position, the old trusses and floor were blocked up and the trusses razed. The old stringers were cut through with a flame above one of the new floorbeams in each panel and four stiffener angles and temporary cross frames riveted to them. This was done throughout the span before any of the panels of the new floor system were raised to their final position. The taking out of the old floor system and raising the new to its final position was accomplished without holding up trains more than an average of 40 min. per panel. The record time for one panel was 28 min., and the two center panels, which were changed in one operation, required one hour.



TWO FLOORBEAMS AT EACH PANEL POINT

The new floor was first erected about 6 ft. below the final location.

The placing of the pier girders on the piers at the ends of the main 525-ft. span was started Aug. 31, 1914, and finished on Sept. 18. Erection of steelwork of the anchor spans was begun Sept. 23 and completed by Jan. 11, 1915. The erection of the main trusses then proceeded until they were finally swung on Feb. 18 by jacking up from the end steel bents sufficiently to make the center connections and relieve the erection ties. Blocking up the old span on the floor of the new started Feb. 20 and between Feb. 26 and March 18 the old span was completely razed. The new 525-ft. span was practically completed by March 19, 1915.

These truss spans were fabricated and erected by the American Bridge Company for the Pennsylvania Lines West of Pittsburgh. J. C. Bland is engineer of bridges of the railroad. Richard Khuen, Jr., and later L. H. Shoemaker, were in charge of the construction, and H. A. Green, division erection manager of the American Bridge Company, was in charge of erection.

STREET TRAFFIC ACCIDENTS in San Francisco have been reduced, it is stated, since the adoption of "safety crossings" indicated by white bands painted on the pavement, and upon which automobiles are not allowed to encroach until the traffic policeman signals by whistle.

Literature

For the Civil Engineer and Contractor

New Publications

REPORT OF THE BUREAU OF BUILDINGS OF THE BOROUGH OF MANHATTAN, NEW YORK. 1914. Cloth; 7 x 10 in.; 99 pages, illustrated.

EXPERIENCES IN EFFICIENCY. By Benjamin A. Franklin. Cloth, 5¼ x 7½ in.; 167 pages. New York, the Engineering Magazine Company. $1 net.

ONE YEAR OF CITY MANAGEMENT IN DAYTON, OHIO. By Lent D. Upson, director. Paper; 6 x 9 in.; 7 pages. Dayton, Ohio, Bureau of Municipal Research.

THE BUDGET OF THE CITY OF DAYTON, 1915. As Enacted by the City Commission. Paper; 6 x 9 in.; 52 pages. Dayton, Ohio, Bureau of Municipal Research.

SANITATION IN PANAMA. By William Crawford Gorgas, surgeon general, U. S. Army. Cloth; 6 x 9 in.; 298 pages, illustrated. New York, D. Appleton & Company. $2 net.

STANDARD CLASSIFICATION OF ACCOUNTS for the use of the city and county of Denver. By Thomas R. Lill. Paper; 6 x 9 in.; 57 pages. Denver, the Colorado Taxpayers' Protective League.

SOME TYPES OF CITY GOVERNMENT. By Lent D. Upson, director, Bureau of Municipal Research of Dayton. Paper; 6 x 9 in.; 8 pages, diagrams. Dayton, Ohio, Bureau of Municipal Research.

YEAR BOOK OF THE DEPARTMENT OF AGRICULTURE FOR 1914. Cloth, 6 x 9 in., 715 pages, illustrated.

Of principal interest to the engineer are the chapters on "State Management of Public Roads," by J. E. Pennybacker, and "The Preparation of Fertilizer from Municipal Waste," by J. W. Turrentine.

U. S. GEOLOGICAL SURVEY—Washington, D. C. Superintendent of Documents. Paper; 6 x 9 in.

WATER SUPPLY PAPER 340K—Stream Gaging Stations and Publication Relating to Water Resources, 1885-1913. Part XI, Pacific Coast Basins in California. Compiled by R. D. Wood. 15 pages, with list of other reports.

WATER SUPPLY PAPER 358—Water Resources of the Rio Grande Basin, 1888-1913. By Robert Fallansbee and H. J. Dean. 725 pages, illustrated.

ROAD MODELS—Bulletin 220, U. S. Department of Agriculture. Prepared by the Office of Public Roads, Logan Waller Page, director. Paper, 6 x 8 in.; 24 pages; illustrated. Washington, Government Printing Office.

This bulletin contains illustrations and descriptions of the models in miniature of roads, bridges and culverts and of road machinery exhibited by the Office of Public Roads at expositions and fairs and on railroads. Methods of construction are discussed.

LIMESTONE ROAD MATERIALS OF WISCONSIN. By W. O. Hotchkiss and Edward Steidtmann. Bulletin 34, Economic Series 16. Cloth; 7 x 10 in.; 136 pages; illustrated; tables and diagrams. Madison, Wis., State Printing Office.

A publication intended to aid in conserving highway expenditures for stone, which, delivered on the road, usually represents two-thirds or more of the total cost of the road. The report contains chapters on the general characteristics of Wisconsin road materials and descriptions of tests on hardness, toughness, per cent of wear, specific gravity and weight per cubic foot, and absorption.

BULLETIN OF THE PACIFIC HIGHWAY ASSOCIATION issued June 8, 1915. Paper; 6 x 9 in.; 20 pages. H. L. Bowlby, executive offices, Chamber of Commerce Building, Portland, Ore.

Official announcement of the incorporation of the Pacific Highway Association on April 19, 1915, the objects of the organization and its rules and by-laws. Ten pages are devoted to a report on the conditions of the Pacific Highway between Seattle, Wash., and San Francisco, Cal., the report having been written by Mr. Bowlby, ex-State highway engineer of Oregon, as a record of a round trip made by automobile over this highway during the month of May. The report notes distances and running time between all stops and comments in detail on the conditions of the road along the entire route.

Books Reviewed

Manual del Ingeniero

Spanish translation of Trautwine's Engineer's Pocket Book. Translator; Alberto Smith, professor of the Central University of Caracas. Cloth, 4½ x 7 in.; 1273 pages; illustrated; diagrams and tables. Paris, France, Garnier Brothers. On sale by A. Smith, 45 Broadway, New York. $5 net.

Only one who has mingled with engineers of the Spanish-speaking countries sufficiently long to have obtained a fair understanding of their ways of thinking and of the language they speak can thoroughly appreciate the value and the difficulties of the translation this author has made. Of recent years a great many of these Spanish-speaking engineers have obtained their education in the United States and have done most of their important work either under the supervision of or in association with Americans, yet the American engineer does not occupy the pre-eminent position he should in the southern countries nor are his standards of practice generally adopted there. The reason is simple—the Spanish-speaking engineer has had to look to others, particularly to the French, to obtain his technical information in a form that is understandable to him and, naturally, with this information he has adopted their methods of procedure. This work will do much to combat this tendency and will serve a very useful purpose. The Spanish is excellent and practical, not the stilted, precise attempt at the pure *castellano* that is, unfortunately, generally the case in American translations of this class, but the easy, understandable Spanish that those for whom it is written speak. It will doubtless be heartily welcomed, particularly by those Spanish-speaking engineers who have been educated in this country. It is complete even to the use of the metric system in tables and formulas, instead of the English system of feet and inches or decimals. In contents the work is identical with the original, so that a reader who understands either of the languages may lay the original and the translation side by side and easily acquaint himself with the terminology of the other.

Irrigation in America

Author, A. D. Lewis, M.A., circle engineer, Irrigation Department, Union of South Africa. Cloth; 8½ x 11 in.; 258 pages, illustrated. Pretoria, South Africa, Government Printing and Stationery Office.

The object of the author in writing this book is avowedly to spread information of the rapid strides made in America in recent years in the irrigation of arid lands and methods of inducing settlement thereon. Many valuable examples of engineering methods in constructing high masonry and earthen dams are given, and even more valuable lessons are derived from the results of settlement. Seventeen of the more modern irrigation schemes which the author inspected during a trip in the United States in 1913 are described and well illustrated. Each scheme is described separately in all of its aspects and with special reference to the results achieved in settlement, which is, as the author states, the measure of the success of irrigation and depends on conditions which vary with each scheme. Failures have resulted not so much from bad engineering as from lack of proper understanding of agricultural conditions and the human element involved.

A uniform method of description has been followed so that information on any one aspect of irrigation can be conveniently found and brought together. One chapter describes some useful crop experiments in Utah and two chapters are devoted to settlement and irrigation law. The book describes the following schemes of development: Bellefourche in South Dakota, Huntley in Montana, Shoshone in Wyoming, Boise in Idaho, Minidoka and Twin Falls on Snake River, Oakley and Salmon River, Truckee-Carson in Nevada, Modesto-Turlock, Fresno, Redlands, Imperial Valley and Yuma in California, Salt River in Arizona, and the Rio Grande in New Mexico. A summary of important points and general comparisons closes the volume.

Guidebook of the Western United States

Part B. The Overland Route from Missouri River to the Pacific Coast, with a side trip to Yellowstone Park. Authors, Willis T. Lee, Ralph W. Stone, Hoyt S. Gale, and others. U. S. Geological Survey Bulletin 612. Paper; 6 x 9 in.; 244 pages, illustrated. Washington, D. C., Superintendent of Documents, $1.

Every traveler may now enjoy the luxury of being "personally conducted" on a transcontinental journey which will afford an intimate acquaintance with the country through which he passes. This volume, the first of four which will appear in rapid succession, covers the route from the Missouri River to the Pacific Coast. The next to come, that covering the Northern Pacific route, so closely identified with the Lewis and Clark Expedition of 1803-1806, will be published in a few days; and those describing the Santa Fé route and the Shasta and Coast route will follow soon.

The value of these guides to travelers interested in this country cannot be measured. The route is followed from station to station, and human history, geologic history, agricultural and mining values—everything, in short, that can make a car-window landscape vital and interesting is succinctly and rapidly sketched.

The guide books are full of items of general interest that will answer such questions as the average intelligent traveler is continually asking. In a broad way the story of the West is a unit, and the aim of this description of the western United States is to meet the needs of the American citizen who desires to understand what he sees. In the preparation of the book on the overland route much information already in the possession of the Geological Survey has been utilized, but to supplement this material three geologists last year made a field examination of the entire route, where special topographic surveys for the accompanying maps were made by survey engineers. The route is covered by a series of twenty-nine complete and accurate maps, which are so arranged that the reader can unfold them one by one and keep each map in view while he is reading the text relating to the portion of the route it represents.

The book is, as a whole, distinctly popular in character, and is freely illustrated with half-tone plates of some of the most striking views and objects to be seen on the journey and with pictures of prehistoric animals that inhabited the West in ages past, when Nebraska and Colorado, for instance, were huge swamps frequented by strange beasts whose fossil remains are now found in the rocks formed from the sand and the mud of the ancient swamps, which have since been elevated thousands of feet.

The book should prove a distinct boon to any traveler, and its low price makes it available to all.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Florida's Sand-Asphalt Roads

SIR: Your journal is quoted in this State to discourage sand-asphalt construction of our roads. Please do the facts the justice to state with regard to the Eustis sand-asphalt road (see Engineering Record, May 15) that it was laid upon sand, the old clay road having been excavated to permit of proper grading for the sand-asphalt surfacing. That is the fact, and this is the third summer the road has been in continual use and not a cent's expense has been involved in its repair, and it is as good as new.

Secondly, there is no truth in your information that an inch of sand is kept spread upon this sand-asphalt road to protect it from sun or traffic. Connected with this road is a stretch of sand-asphalt surfacing laid upon 15 in. of fresh sand in and around the New Ocklawoha Hotel garages. This surfacing is perfect, and requires a heavy adz to separate it.

We have just let a contract for 20 miles of this sand-asphalt, 15 ft. wide, on 4 in. of new clay, the total cost being 66 2/3 cents per square yard. Do you suppose we will waste our bond money on a material that has for 3 years in our midst withstood not only the destructive agencies of heavy traffic, but the malicious misrepresentations of this cheapest, best and most practical road material in this sandy, "hot" State of Florida?

CLARENCE E. WOODS,
Editor "Eustis Lake Region."
Eustis, Florida.

Propriety of Government Surveys for Local Use

SIR: The engineering profession must accept as a fact the existence of serious competition by certain Government bureaus. This conclusion was not only arrived at through consideration of statements by the director of the U. S. Geological Survey appearing in the Engineering Record of May 29, page 682, but rests also on additional evidence which has been supplied the writer by engineers in various parts of the country—engineers of high standing—many of them members of the American Society of Civil Engineers. These cases cover the various fields of hydroelectric, drainage, road and water supply engineering. One correspondent, referring to a recent case in which the Government is now doing drainage work, and for which he did missionary work, says:

"This is by no means the first instance in which I have suffered. If I read the signs of the times correctly, it will be impossible for an engineer to remain in general practice of engineering, in a very few years, if the Government bureaus continue to expand."

The director of the Geological Survey, in his statement in the Engineering Record, makes no denial that his bureau entered into competition with fourteen private engineers or engineering firms in the Harris County, Texas, case, but attempts to justify that action on the ground of mutual benefits to both the Federal Government and to the locality. The statements that the Harris County co-operation follows precedents in form, and is a mutual benefit to both contracting parties, are open to challenge. With regard to the various co-operative surveys named by the director as being precedents for the Harris County work, the official records of his bureau show that without exception these surveys were *State* co-operation undertakings, legally provided for under some act of a State legislature, and participated in by some *State* official. The Harris County survey is not in any sense a State undertaking, nor are the county officials who are party to the contract under which the Geological Survey is doing the work in any sense *State* officials.

In the year 1910 a pamphlet was issued by the U. S. Geological Survey exploiting its policy of co-operation. In that pamphlet it is stated (page 4) that "The object of the State in these agreements was to direct and promote topographic mapping, geologic investigations, etc." Further on we find that "the director is willing to enter into co-operative agreements only when the interests of the country as a whole will be benefited." The Harris County survey is distinctly a local survey for purely local benefits, and the engineers of the country will do well to note that it is the *first* (in so far as I can learn) purely local survey to be made by the U. S. Geological Survey in direct co-operation with distinctly local officials. It is also of pertinent interest to note that the request for co-operation did not originate with the county officials, but with the local Chamber of Commerce. This is but another departure from a so-called precedent in co-operative work, the director claiming that in all cases the request for co-operative surveys must originate with the co-operating officials. In another case it is known that co-operation was sought by the U. S. Geological Survey officials.

In challenging the director's statement that the Harris County work is one of mutual benefit it is necessary to investigate only along the lines of his published statement that the policy of co-operative surveys was undertaken in order to *hasten* the progress of making the topographic map of the United States, a project now about 40 per cent complete. It is admitted that State co-operative surveys which have to do with the production of maps on standard scale do hasten that progress and are of mutual benefit to State and nation, but the same is not true of co-operation on detail surveys of a scale materially larger than the standard. By departing from its legal function of making foundation topographic surveys and undertaking detail surveys for local engineering projects the Geological Survey not only does not hasten the progress on the topographic map of the United States, but that progress is thereby materially retarded.

The employment of a Government topographer on detail surveys naturally takes him away from his legitimate work, and as a consequence he maps in a given season only about one-fifth as much territory as he would ordinarily have done. This ratio of one-fifth is believed to be near the truth in the Harris County survey, though if we accept the statement that the contributed sum of $5,000 is not a bonus, but represents the Geological Survey's interest in that county survey, a survey costing some $90,000, the ratio should be one-seventeenth. It being an established fact, recognized by the director of the Geological Survey, that the time and cost of topographic mapping is almost in direct proportion to the scale of the mapping, the sum of $85,000 must represent the additional work to be done in Harris County by Government topographers due to the special needs of that county. In any event, it must be clear that the U. S. Geological Survey would have to undertake only a few surveys similar to the Harris County survey to tie up a good part of its trained force on detail surveys, thus materially decreasing the area which it annually maps, and thereby postponing for an indefinitely long period the completion of the topographic map of the United States, one of the prime duties with which Congress has charged this bureau.

The benefit of this survey to the county must also be questioned. The director states that the Geological Survey is not engaged in the making of drainage plans. Will a survey planned by them meet the needs of Harris County as well as a survey planned by engineers of long experience in drainage and detail topographic work? It was the opinion of well known drainage engineers interested in the Harris County work that the clause in the county engineer's specifications on which bids were made, calling for 1-ft. contours on the topographic map, was a proper one and was needed for the making of complete drainage plans for the county. This is also in accordance with the best engineering practice. Despite this, the Geological Survey proposes to make a map with the 5-ft. contours located and the intermediate contours sketched (?) in. This map is to be used as a basis for complete drainage report and plans for Harris County, a very level section of coastal plain, with large prairie areas having slopes of as little as 2 ft. to the mile. Only time and the completion of work based on plans so prepared can tell if the county has really made a start at securing successful and adequate drainage, but the engineering public will, I believe, admit that the odds are against any such plans being successful.

In his letter to the Engineering Record the director of the Geological Survey enunciates the following policy for his bureau: ". . . This Survey feels not only warranted but compelled by a broad public policy, in large undertakings similar to the mapping of Harris County, an area of nearly 1700 sq. miles, to give all the assistance possible when so large a public interest is involved."

It is desired to call the attention of the engineers of the country to this stated policy. It concerns every one of them, if not now, then at some not far distant day. If the U. S. Geological Survey is to be permitted to establish a policy whereby it can undertake detail surveys at will—if, after thirty years of co-operation with the various States it now feels authorized to undertake county work—what assurance have we that precinct and small drainage surveys may not also be undertaken by this bureau? The trend is surely in that direction, and *now* is the accepted time to voice a protest and to insist on proper remedial action. In the hands of the engineer lies the remedy—publicity and legislation. To each and every engineer—to you who have felt the weight of Government competition and to you who have yet to feel it—I say seek publicity and legislation. Publish in your journals and before your societies what you know of this matter, and in this way a competent collection of facts will be gathered and an honest public opinion developed, and when the proper time comes legislative action will be assured compelling attention and fair and complete remedial measures.

W. N. Brown,
Of Brown & Clarkson,
Civil and Mining Engineers.
Washington, D. C.

New Theory of Cast-Iron Water Main Breaks

Sir: I have read with much interest the editorial in the Engineering Record of May 8, page 574, under the heading of "New Theory of Water Main Breaks." They invite suggestions as to the best way of laying cast-iron water mains, especially sizes from 12 in. upward, so that there would be no maintenance expense or broken mains caused by settling, expansion, contraction, or radius extension. The latter might be caused from internal pressure that would increase the curvature of the pipe line if laid without bends.

In order to take care of a certain amount of expansion which we had theoretically estimated for a 12-in. line crossing a river and supported on the brackets of a concrete bridge, we cut out ⅛-in. cloth-inserted sheet-rubber rings and placed them between the shoulder of the socket and the spigot end of the pipe. This we estimated would crush if the pipe increased in length any, whereas the regular allowable expansion is taken care of when the pipe shortens by the compression of the jute which is usually put in the joint in advance of the lead. We used this method because the pipe had to be laid upon very short notice, and we did not have time to purchase an expansion joint, which we understand would have overcome any theoretical as well as practical troubles from expansion on this line.

On work where the mains are laid around a curve or deflected from a straight line in any direction without using bends, we have always been afraid to lay the joints off a straight line if the taper of the lead which is run into the joint would be more than ⅜ in. per foot, which is really too much for any size pipe under 12 in. Our reason for this is that if there is any material amount of taper the lead has a tendency to slip or work out of the socket or bell of the pipe, especially on the outside of the curve. The inner side, being compressed at the mouth of the bell, forms what might be termed an inverted wedge and would have a tendency to drive it toward the bottom of the bell or shoulder of the socket.

An offhand conclusion on the Cincinnati trouble, noted on page 588 of your issue of May 8, is that the spigot end of the pipe must have been bearing very heavily against the side of the socket or bell, this pressure having been increased probably by reason of the excavation which, made near the pipe line, caused it to shift slightly. It is possible, also, that the radius of the pipe was increased by internal water pressure, or probably some water hammer caused from irregular action of the pumping station, or perhaps from some very unusual opening and closing of valves or hydrants.

We understand very readily that the manufacturer contends that cast-iron water pipes are designed to withstand certain heads or pressure, and when laid in a trench they are to be in a straight line, and if any irregularity is to be made in this line exceeding 6 to 9 deg. per 100 ft., they advise the use of bends. On the other hand, we believe that large pipe of any size from 12 in. upward should be carefully laid. Where there is a reasonably firm earth the trench should be carefully dug so as to provide a proper bearing for at least two-thirds of the length of a 12-ft. pipe. Then there should be some good tamping of the earth on each side of the pipe.

We do not believe in the method that is very often pursued in digging a trench to irregular depths and then just blocking up the pipe at each end and dragging the loose earth back into the trench with a scraper. This method invariably allows the pipe to settle down before the earth really becomes set and packed around the under side of the pipe. Where the earth is not sufficiently firm to offer good support for the pipe, we would have it set on piling or concrete piers.

While these methods may bring about high first construction cost we believe that eventually they will be a justifiable expenditure in waterworks construction.

H. J. Weierhauser,
San Antonio Water Supply Company.
San Antonio, Texas.

Remodeling Old Septic Tanks

Sir: I note with interest the editorial "Remodeling of Old Septic Tanks" in your issue of June 12, page 731, and would say that last year I constructed an Imhoff tank at the inlet end of an old so-called "septic tank" which had been pretty much of a failure. There was built also a covered nitrification bed provided with aerators, with the result that a most excellent effluent is being obtained and one without odor whatever, either at the discharge from the old tank or at the discharge from the nitrification bed. The plant referred to is now in successful operation at the Crippled Children's Home near Elgin, Ill., serving seventy-five persons.

The sewage treatment and plant at the Cook County Infirmary, Oak Forest, formerly comprised two so-called "septic tanks" and four contact beds. This plant was remodeled by adding a detritus chamber, an Imhoff tank, hypochlorite plant and four additional contact beds with the result that, so far as physical examination goes, a most excellent effluent is being obtained and has completely set aside the nuisance which the former plant was producing along the farms through which the sewage flows in an open ditch for several miles and empties into the Little Calumet River. This plant is designed to care for 5000 people. The hypo plant in this case is interposed between the new Imhoff tank and one of the old septic tanks, which is now converted into a settling tank. From this settling tank the discharge is made directly into the control chambers of the contact beds.

Burton J. Ashley,
Consulting Engineer.
Chicago.

Levee Districts in Louisiana number seventeen. All but two of them—the North Bossier and Cat Island districts—are in operation.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Keep Traffic Off Newly Grouted Granite Block Paving

IN HIS REPORT for 1914 R. A. Cairns, city engineer of Waterbury, Conn., emphasizes the importance of excluding traffic from freshly grouted granite block paving. The success of this class of pavement, he states, depends largely on accurate cutting of the blocks, and on thorough grouting. To secure well cut blocks they should be bought direct by the city and inspected at the quarry before shipment. After the street is torn up and the public is impatiently demanding that the work be hastened, there is little opportunity for rejection of blocks which are not quite up to standard. Thorough grouting requires close attention to every detail, and even when properly executed will be a failure unless travel can be absolutely excluded and all disturbances prevented until the cement has become well hardened.

The experience at Waterbury is that this usually requires from two to three weeks, and that when sooner opened to travel the blocks are loosened, the grouting chips out of the joints, and the pavement never can have the smooth surface which is so desirable. There are places in the pavement laid recently where the work was well done, but the grouting was ruined by teamsters deliberately removing the barriers and driving over the work in spite of the protests of inspectors and contractors.

Floating Driver Places Seventy-five Piles a Shift

A FLOATING driver being used on the construction of the Hunt's Point bulkhead in New York City by the Jarrett-Chambers Company, Inc., regularly places from 60 to 75 piles each 8-hour shift. Many of these piles are driven at a 60-deg. angle. The driver is of the "moonbeam" type. The leads are pivoted near the top of the ladder, and swing to one side beyond the edge of the hull in driving batter piles. They are secured in this position by a toggle block framed into the moonbeam timbers, and sliding on a bolt through a slot in the timber. The leads are pulled to either side of the boat by lines running to nigger-heads on the hoist. Of course, the hammer is pulled to the top of the leads before they are swung over. A No. 1 Vulcan steam hammer is used, and 40 to 55-ft. piles are driven. The average penetration is 15 ft. in compact sand and gravel. No jet is used.

DRIVING PILES AT A 60-DEG. ANGLE

TOGGLE SLIDES OUT TO CATCH LEADS

Large Number of Light Needles Hold 606-Ton Brick Wall

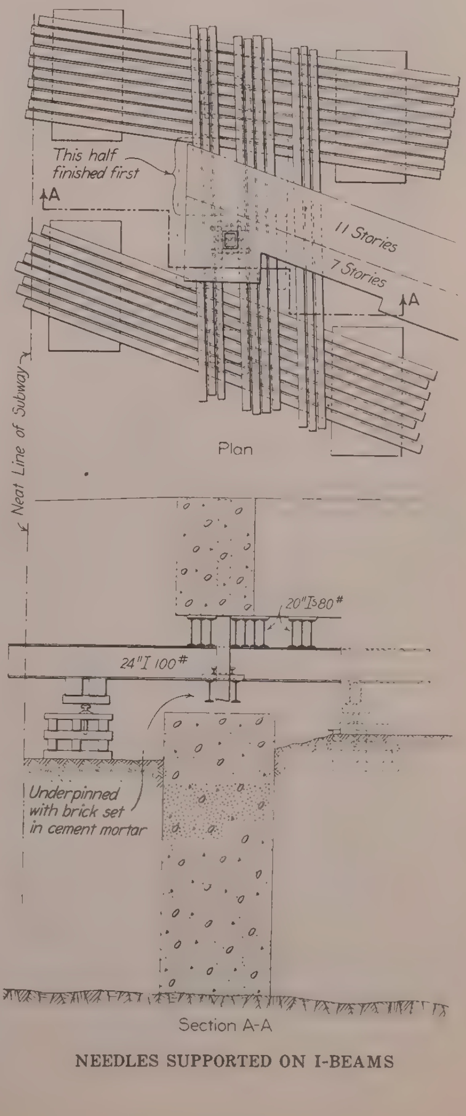
THE brick party wall between Nos. 1128 and 1130 Broadway, near Twenty-eighth Street, New York City, now supported on needles, weighs 606 tons. This is said to be the heaviest load yet underpinned in building the new subways. This wall is 8 ft. thick at the building line and 6 ft. thick at the back of the cut made to underpin it. The building at No. 1128 is seven stories high, and that at No. 1130 is eleven stories high. The street face of the latter building is supported entirely by the two side walls.

Three sets of needles were run through the wall, the center set being placed first and the side sets later, all supported on two banks of I-beams, one at each end of the mean top needles. These, in turn, rest on stringers of timber or I-beams under which fifty-six 3-in. screw-jacks are set on the four separate timber cribs. These jacks have a combined capacity of 1120 tons. The four main cribs load the soil to 2 tons per square foot. The soil was first tested and found good for 4 tons. The bearing between the top needles and the wall is made of 3-in. plank set in cement mortar.

As soon as the first set of needles was placed through the wall, a strain was taken on the jacks. To tell when the weight of the wall had been lifted, the brick work was tapped with an 8-lb. maul above and below the cut, a difference in the sounds of the blows showing very accurately when the wall had been picked up. The same method showed when it was necessary to take up on the jacks to keep the wall lifted as the holes for the remaining needles were cut. A small cast column was found in the wall, which did not come up when the wall was raised, and therefore had to be picked separately. What this column carried is not shown on the building plans on file. Three 2-in. pins were run through it, bearing on short I-beams which in turn bear on beams parallel to the upper needles and are supported on cribs on the ground beneath the main bearing needles.

With the wall lifted, the north half of the 7 x 9-ft. underpinning pier was sunk to rock and concreted before sinking the south half. This procedure made a smaller open hole in the ground, and thus minimized the danger to the cribbing from a broken water main or other accident. Wood sheeting was used, being driven by hand to hardpan, as quarters were too close for an air hammer, and under cut and tapped down through the hard pan to rock.

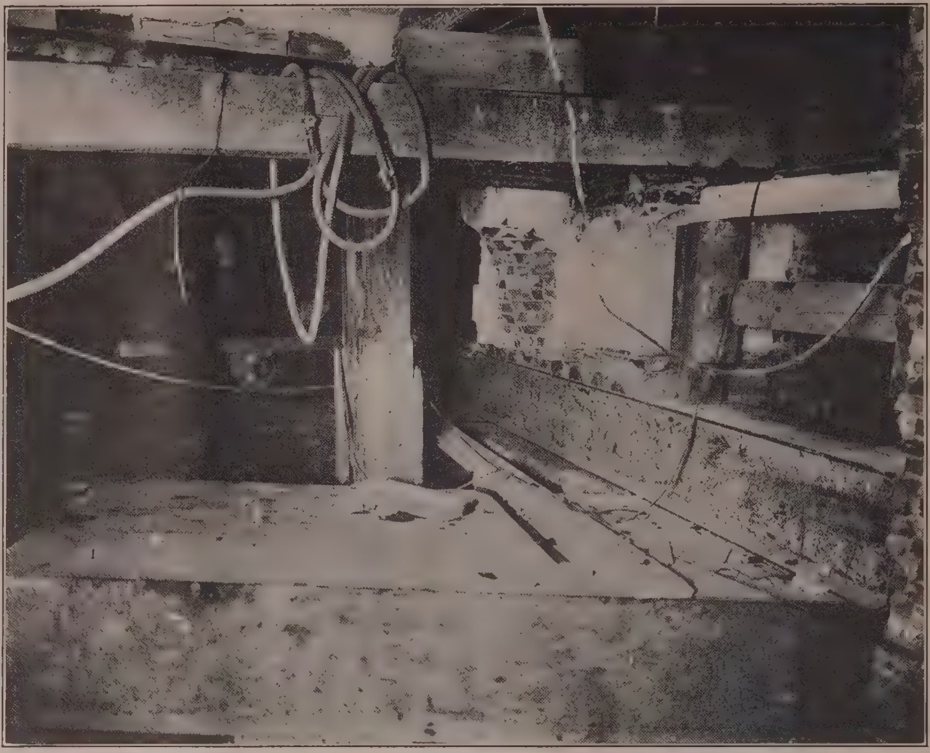
After the pier is concreted it will be built up between the main carrying needles and the upper bearing needles, using brick laid in cement mortar. The joints between this brick work and the old wall will be filled with cement mortar wedged in with slate. When this has set, the wood over one set of bearing needles at a time will be chiseled out, the needle beams withdrawn



NEEDLES SUPPORTED ON I-BEAMS

and the holes they occupied bricked up and wedged. This will be repeated with each set of upper needles. The brick are, of course, laid from the center out, and wedged up a course a time.

The work is being done by the Friestedt Underpinning Company, sub-contractors of the E. E. Smith Contracting Company, for the Public Service Commission, of which Alfred Craven is chief engineer and Robert Ridgway engineer of subway construction. For the commission Charles P. Madden is section engineer, J. O. Shipman, engineer of the first division, and A. J. Mayell, assistant division engineer.



NEEDLES THROUGH PIER REST ON TWO BANKS OF 24-INCH BEAMS

Steel Billets Needle Bridge Shoe in Quarters Too Close for Beams

By T. J. WILKERSON
Division Engineer, Division of Bridges, Pittsburgh

TWO SETS of special steel billets were used to pick up a bridge shoe in Pittsburgh in order to replace the roller nest under it, in which the segmental rollers had turned over. When the north 531-ft. steel span of this structure, the North Side Point bridge, was erected, the segmental rollers were set that they would be in proper position when the entire dead-load was on the span. As the roadway paving and reinforced concrete sidewalk slabs were not in place at the time of the extreme cold weather during the winter of 1913 and 1914, the temperature contraction in addition to the lack of elongation in the bottom chord, due to the paving loads not being in place, caused the rollers to pass the safety point and tip over.

Owing to the crowded condition of the roller shoes on the pier, it became necessary to devise a very compact strong frame for lifting the shoes. The load to be lifted was about 630 tons. The city requested several responsible parties to bid on the work, asking each bidder to submit with his bid a plan showing how he proposed to lift the shoe. The plan submitted by the successful bidder was checked by the writer and found satisfactory, excepting a few minor details which in no way affected its strength, and this plan is shown herewith.

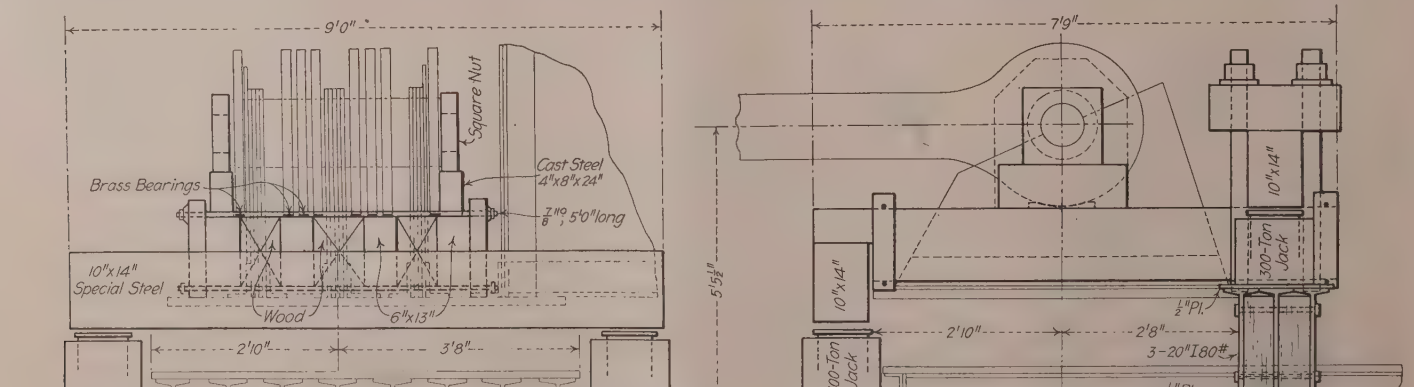
The framing consisted of four 6 x 13 in. special steel billets, two of which passed through between the ribs of the shoe and took bearing on the I-bar heads with an intervening brass plate, while the other two took bearing on the pin ends by means of large square nuts which replaced the regular pin nuts. These four billets were carried by two other special steel billets 10 x 14 in. in size, one placed in front and one at the rear of the shoe. Each of these billets rested directly on two 300-ton jacks. The jacks were carried on two distributing beams, each composed of three 15-in. 60-lb. I-beams, which rested directly on the heavy grillage girders in the pier.

The equipment was placed and a slight load put on the jacks to see that everything was in working order before noon. Work was resumed at 1 p. m., the span raised, the rollers set up and the span lowered on them at 5 o'clock in the afternoon. When the shoe was lifted the top bolts connecting the side-bars to the rollers were found to be sheared off, which necessitated raising and adjusting each roller separately, and caused some delay in the work.

The billets used were of chrome nickel steel, the test of which showed an elastic limit of 68,400 lb. per square inch, and an ultimate tensile strength of 111,600 lb. per square inch.

Each pair of the four 300-ton capacity jacks was connected by an equalizer to one pump. In addition to these jacks, one 125-ton hydraulic jack was placed under the end floor beam to relieve the shoe of the deadload from this beam. The work was executed by the Pittsburgh Construction Company, under the personal direction of their chief engineer and general superintendent, and was done for the Bureau of Engineering of the City of Pittsburgh, N. S. Sprague, superintendent, and directly under the personal supervision of the writer.

WISCONSIN BUILT 1350 MILES OF ROAD in 1914, in 71 counties, at a total cost of $3,929,718.



STEEL BILLETS OF EXTRA STRENGTH REQUIRED TO RAISE BRIDGE SHOE IN CLOSE QUARTERS TO RESET ROLLER NEST

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Specifications Submitted for Hollow Building Tile

First Meeting of Manufacturers' Association Suggests Building Code Requirements and Discusses Promotion Work

Specifications for hollow building tile, for incorporation in municipal building codes until the American Society for Testing Materials shall draw up specifications for this material, were submitted July 13 at the first semi-annual meeting, in Indianapolis, of the Hollow Building Tile Manufacturers' Association. The specifications were originally reported in May, revised in June, and submitted in final form at the Indianapolis meeting this week. It was voted to publish the specifications with an explanation that they are based on tests and studies of three successive building commissioners in Cleveland and the Osborn Engineering Company of that city. Copies of the specifications may be secured from the secretary of the association, whose address is 824 Engineers Building, Cleveland, Ohio.

The principal requirements of the specifications are as follows: Maximum absorption, 12 per cent; average ultimate crushing strength, 2500 lb. per square inch of net web area tested; maximum permissible load, 200 lb. per square inch of vertical web. Within fire limits the wall thickness must be the same as for brick construction.

The Indianapolis meeting was devoted chiefly to a consideration of the future activities of the society in publicity and promotion work. The principal addresses were made by H. Tolles, of the Chicago Association of Commerce; E. J. Mehren, editor of the Engineering Record, and E. C. Zorn, of the *Brick and Clay Record.*

Construction Commences on Canadian Government Observatory

The contract for the construction of the structure to house the 73-in. reflecting telescope which is being built for the Canadian Government, and which is to be installed at Victoria, B. C., was awarded to the McAlpine, Robertson Company of Vancouver, B. C., on June 12. Preliminary work was at once commenced, and the mountings for the telescope are to be ready by next October. The contract price was $75,000.

The observatory building surmounted by a dome 60 ft. in diameter, will be located at an elevation of 700 ft. above sea level on Little Saanich Mountain near the city. A description of the astronomical equipment appeared in the Engineering Record of June 6, 1914, page 656.

Cincinnati Storm Does Million Dollar Damage

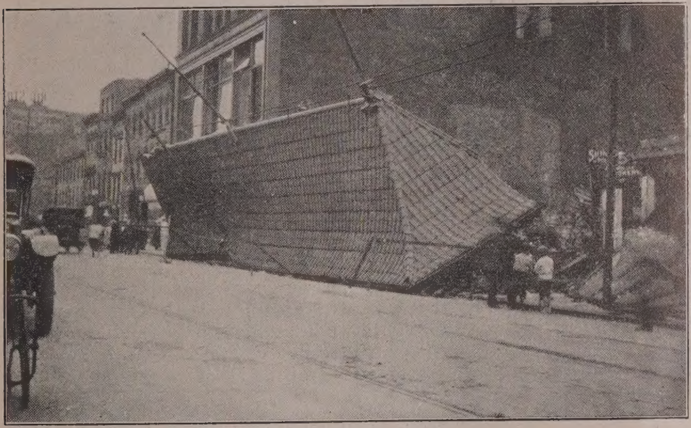
Roofs Blown from Buildings—Church Steeples Fall —Railroad Cars Swept from Tracks by Wind

By J. W. ELLMS

Consulting Engineer, Cincinnati

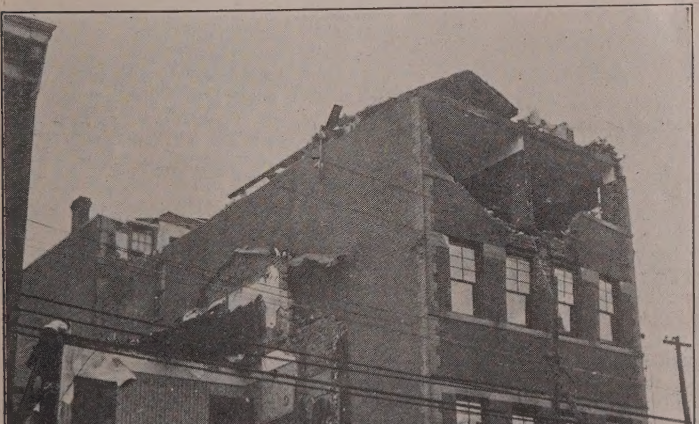
A severe storm of wind and rain passed over Cincinnati, Ohio, about 9 p. m., July 7. For about half an hour before its full violence broke lightning and thunder gave warning of its approach. The velocity of the wind rapidly increased, reaching a speed of 62 miles an hour in the business district and as high as 50 miles per hour on the hill tops in the residential section. Both of these wind velocities are from the official records of the Weather Bureau at their observation stations. The rainfall amounted to 1.01 in. and of this amount 0.66 in. fell in 9 minutes, commencing at 9.24 p. m. The highest rate of precipitation was 0.55 in. in a period of 5 minutes. The storm occurred in connection with the eastward movement of a low pressure area, which passed from northwestern Iowa on July 7 to northeastern Ohio on July 8.

The loss of life in Cincinnati and vicinity and the damage to property exceeds anything that has ever visited this locality. It is known that 31 persons were killed, and it is



ROOF OF CINCINNATI STORE FALLS INTO STREET

WORKERS REMOVE DEBRIS OF COLLAPSED STRUCTURE



STORM DAMAGE AT EIGHTH AND CUTLER STREETS

MANY BODIES WERE REMOVED FROM THIS WRECKAGE possible that as many as 50 persons lost their lives, as about a score of persons are missing. It will probably never be known how many people were drowned during the storm. Search for the dead and missing was in progress for 48 hours after the storm had passed. Many people were injured by flying debris and from the caving in of buildings.

It is believed that property losses will amount to over $1,000,000 for Cincinnati and Hamilton County alone. The property losses in the Kentucky cities opposite Cincinnati will reach many thousands of dollars, but no lives were lost, so far as known, although some persons were injured.

Buildings Lose Roofs

The losses in the business district are confined largely to the dropping of signs, and to a heavy loss from broken glass windows. Many houses in the basin of the city were unroofed or badly damaged, and several were demolished. In the collapse of these buildings occurred the greatest loss of life. Two church spires were blown down during the storm in Cincinnati, and one in Covington, Ky., while another in the latter city is so badly damaged that it will have to be taken down.

In the suburban and residence district on the hilltops thousands of shade trees, many of them very large, were either uprooted bodily or broken off by the force of the wind. The damage to crops in the immediate vicinity of Cincinnati is estimated at $500,000, and results from the leveling of the corn, wheat, oats and grass crops, and the destruction of fruit trees.

The steam railroads suffered some losses. Debris which lodged on their tracks occasioned some slight delay in the movement of trains, but this condition was quickly remedied. The Pennsylvania Railroad had a bad accident to one of its trains in the outskirts of the city. One car of the train was blown off the track, pulling another with it. Three men were killed and nineteen injured in the wreck.

The city street car lines were able to give good service by prompt attention to broken wires and poles. The interurban electric car lines were, on the other hand, put temporarily out of business. A line coming in on the western side of the city only suffered a 4-hour interruption of traffic. Practically all of the lines entering the city on the eastern side did not resume service for nearly 36 hours after the storm. The car lines entering the city from the south—that is, from the Kentucky cities—were out of service for 24 hours.

The telephone service of the city and suburbs was crippled in those districts over which the storm passed. The same was true of the electric lighting service both in Cincinnati and in the Kentucky cities opposite Cincinnati.

New York City to Place Largest Municipal Rail Order

Taking advantage of the low prices prevailing in the steel and iron industries, the city of New York, through the Public Service Commission, is going into the market for the largest order of ties, ballast and rails and other track accessories for the new subway and elevated lines of the dual system that has ever been placed by an American municipality.

Some idea of the magnitude of these contracts is obtained by the fact that the orders cover about 35,000 tons of 100-lb. open hearth rail; about 3,000 tons of rolled manganese rail; over 1,000,000 tie plates; about 356,000 cu. yd. of broken stone ballast and about 30,000,000 ft. of ties and timber. The material now about to be purchased, if placed on the New York Central Railroad would be sufficient to lay a continuous single track from the Grand Central Terminal to Utica.

Besides the saving in cost to the city by placing the orders at the prevailing low prices, it is expected that considerable saving will be made in the handling of the material, in that the supply contractor is required to deliver the material directly to the contractors who will lay the track, thus eliminating any necessity for a city store yard. In order to avail itself of this very desirable condition the commission has provided in its forms of contracts that the material be delivered in installments, from time to time, as ordered, for a period of about eighteen months.

The new materials are needed for the track-laying on all lines of the dual system except the Fourth Avenue subway in Brooklyn and the Centre Street Loop subway in Manhattan, which have been already equipped, and the New Utrecht Avenue elevated line in Brooklyn, for which the materials have been ordered. On the new lines of this system, to be owned by the city, there will be approximately 260 miles of single track railroad. In the Fourth Avenue subway and the Centre Street Loop there are approximately 30 miles of single track, and as these tracks have already been laid there remains to be equipped about 230 miles upon other lines. These include the Lexington Avenue, the Seventh Avenue, Broadway, Canal Street, William Street and Nassau Street subways in Manhattan; the Jerome Avenue, the White Plains Road and the Southern Boulevard extensions in The Bronx; the Eastern Parkway, Nostrand Avenue, Flatbush Avenue, Eastern District, New Utrecht Avenue, Gravesend Avenue and Livonia Avenue lines in Brooklyn, the three new tunnel lines under the East River, the Astoria and Corona elevated lines and the Queensboro subway extensions in Queens.

Texas Paper Appreciates Engineer

In commenting in very favorable language upon the report rendered by E. E. Sands, city engineer, of Houston, Texas, on the development of the ship canal and Houston Harbor, the *Houston Chronicle* had the following to say regarding the engineer:

"This city is entering upon a great epoch. For the moment its destiny is in the hands of engineers—more particularly its own engineer. And right here let it be remarked how important the engineer is becoming, and how little recognition his services have received. He is the man who does things...... He is the man with whose work we come in contact on every avenue of life, and upon whose skill and cunning rests in large measure the growth and prosperity of this country.

"If somebody writes a trashy book or paints a smutty picture, we rave, call it art, and vote to put a new statute in the hall of fame, but the engineer we still consider as rather commonplace, rather tiresome and prosaic."

"Lord Baltimore" Makes Dramatic Test of City's Sewage Plant

Calvin W. Hendrick, chief engineer of the Baltimore Sewerage Commission, has such implicit confidence in the efficiency of the settling tanks and sprinkling filters which comprise the Back River sewage treatment plant that he always makes a particular effort to convince visitors that the effluent from the works is adequately purified by the process. A moving picture concern recently made plans for a feature film showing the return of Lord Baltimore to the city which bears his name. The idea was to have His Lordship tour the city as it is to-day and express his amazement at the changes which time has wrought in the way of tall buildings and monumental civic works.

A trip to the sewage treatment plant was arranged and "Lord Baltimore," in all the splendor of grease paint and Colonial costume, was conducted by Mr. Hendrick from one end of the works to the other, while the moving picture operator reeled off hundreds of feet of film. The climax of the film was arranged to show "Lord Baltimore" collect a glassful of the effluent and drink it as proof of the harmless nature of the purified sewage. The actor apparently thought that when he had secured his sample of the effluent the picture machine would be stopped long enough to allow him to substitute a glass of real water. In fact, he tried to do so, but Mr. Hendrick insisted that there be no "fake" about the picture and refused to allow the reel to be finished unless the sewage treatment plant were put to an actual test. It took a long time to convince "Lord Baltimore" that the educational value of such an act would be worth while, but Mr. Hendrick stood his ground and finally the glassful of effluent was gulped down while the picture operator "filmed" His Lordship in this act of martyrdom to the cause of sanitary engineering.

Personal Notes

B. H. Klyce has been appointed city engineer of Miami, Fla.

G. H. Yocco has been appointed city engineer of Los Gatos, Cal.

S. L. Tolman has been appointed a junior assistant on the engineering forces of the New York State Public Service Commission, First District.

William Wells, irrigation engineer, of Woodland, Cal., has been retained by officials of the proposed Southern Lassen Irrigation District to prepare reports and plans.

C. C. Gillespie, assistant city engineer of Sacramento, Cal., has been appointed chief engineer of the State Sanitary Engineering Bureau by the California State Board of Health.

T. H. Johnson, formerly assistant city engineer of Sioux City, Iowa, has been appointed city engineer, succeeding Fred C. Smith, whose resignation is noted elsewhere in these columns.

The W. J. Sherman Company, consulting engineers, of Toledo, Ohio, have been retained by the city of Menominee, Mich., to prepare detailed cost estimates of a proposed municipal waterworks system.

The Solomon-Norcross Company of Atlanta, Ga., has been appointed consulting engineer for the city of Lexington, Ky., to prepare report and preliminary plans for the proposed sewerage system, prior to a bond issue.

T. W. Norcross, assistant chief engineer of the United States Forest Bureau, Washington, D. C., has been touring the West and inspecting various existing and projected power developments on the Pacific Coast and in other western States.

A. L. Upham, formerly resident engineer with the Massachusetts highway commission, has been appointed paving inspector for the city of Woonsocket, R. I., on the granite block paving in that city, contracts for which were recently awarded.

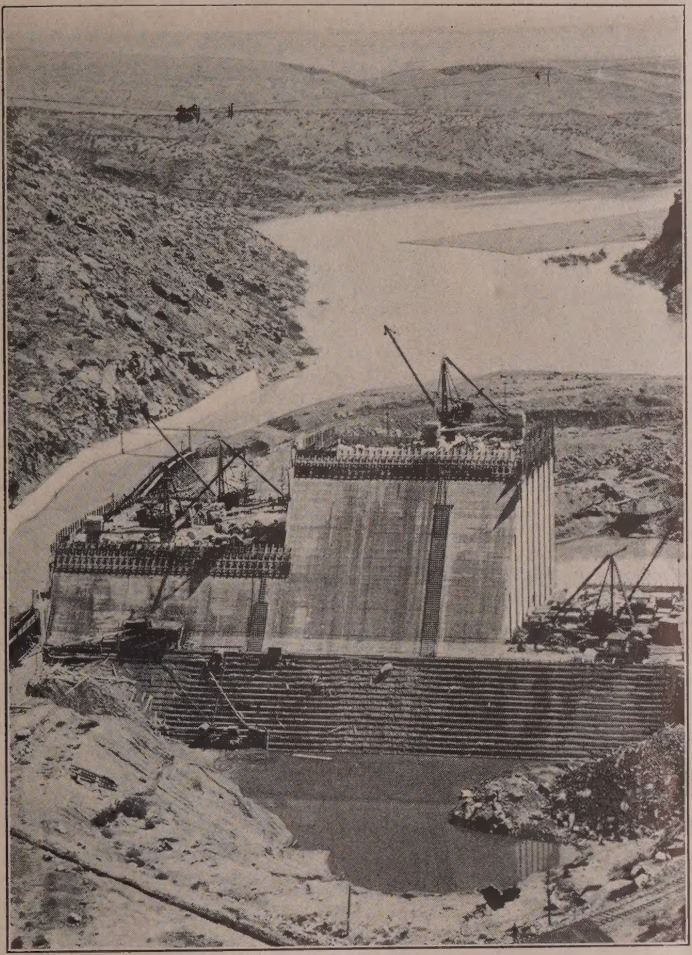
Henry Floy, consulting engineer of New York City, has been retained by the U. S. Department of the Interior to visit, inspect and report on the plant and property of the Mt. Whitney Power & Electric Company in the Legnoia National Park, Cal.

H. J. Bennet, formerly instructor in mathematics at the Derry (Pa.) High School and previous to that transitman for the Buffalo, Rochester & Pittsburgh Railway at Du Bois, Pa., has been appointed a computer in the Washington (D. C.) office of the Interstate Commerce Commission, Division of Valuation.

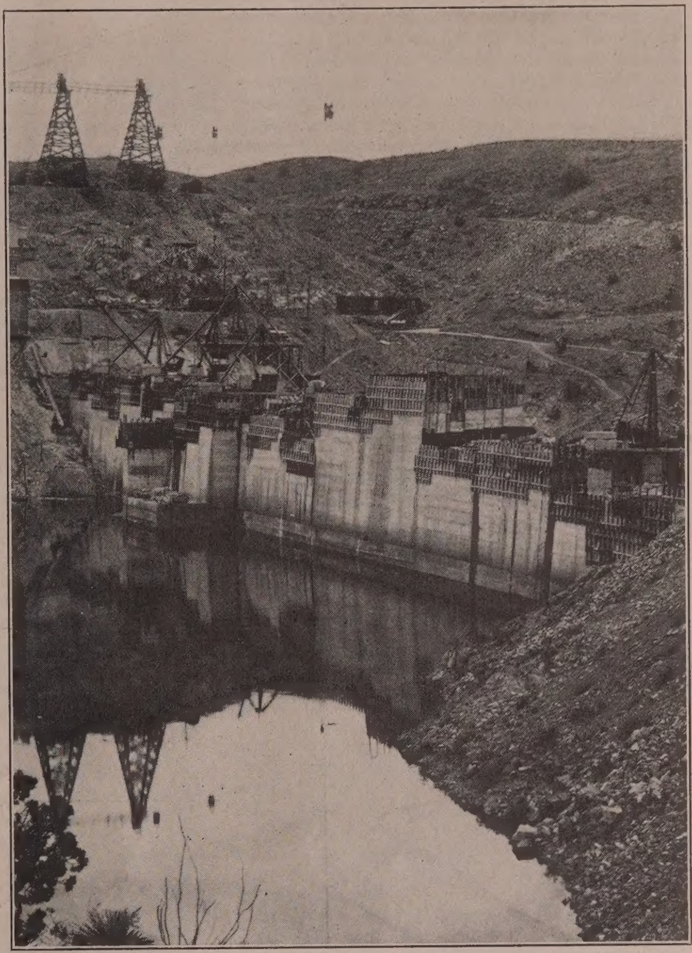
Ray D. Armstrong, U. S. transitman, who was associated with I. W. Stoddard, U. S. surveyor, on the survey of railroad grant lands in Arizona during the winter months, has been transferred to Idaho, where he is in charge of a double party engaged in the survey of railroad grant lands in the Clearwater country.

R. C. Limerick, formerly transitman in the engineering department of the Atchison, Topeka & Santa Fé Railway at Los Vegas, N. M., has been appointed assistant engineer to W. G. Kirkpatrick, consulting municipal and hydraulic engineer, of Birmingham, Ala., and

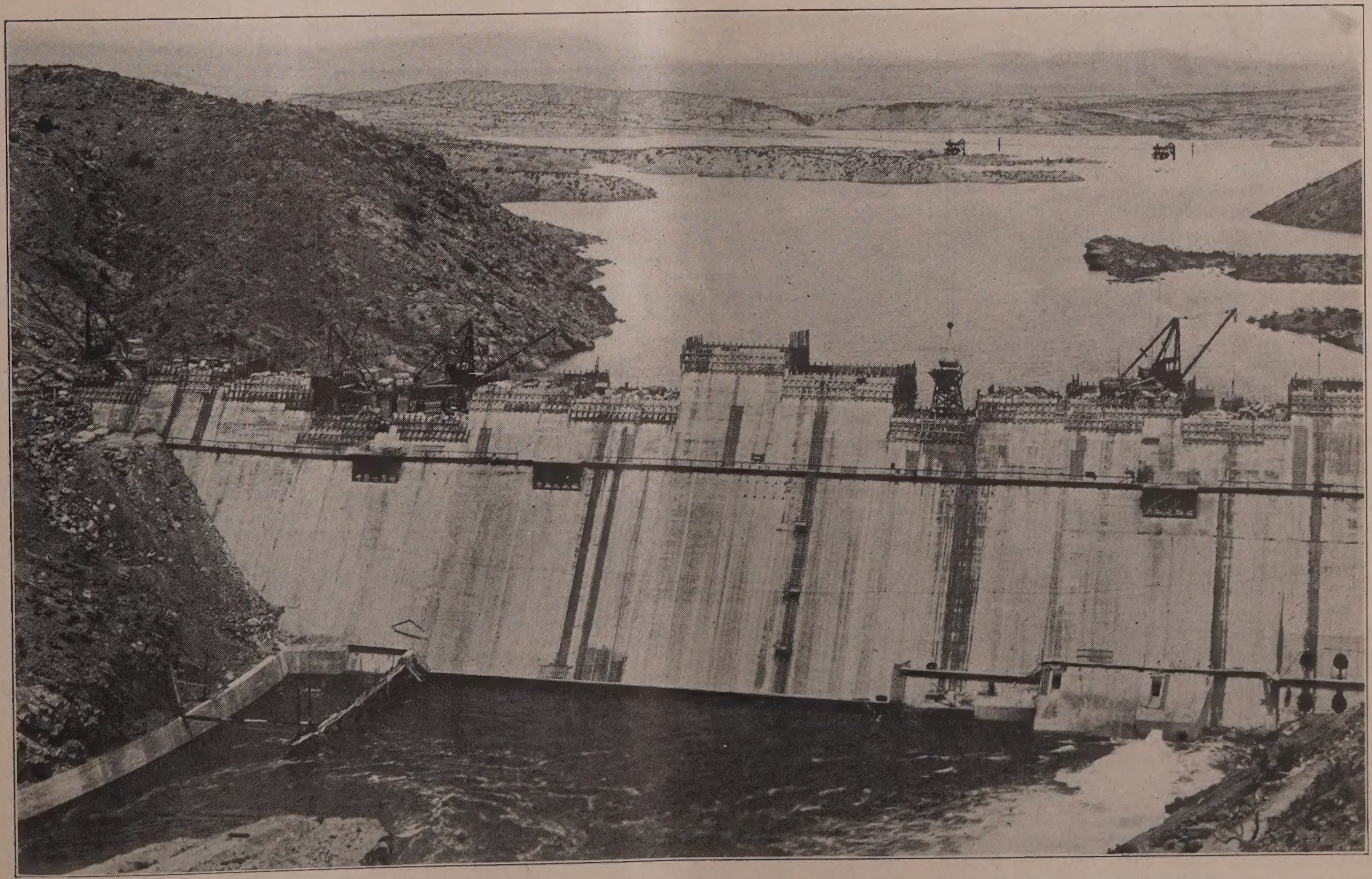
Construction on Elephant Butte Dam for Reclamation Service in New Mexico Nears Completion



DAM DURING EARLY CONSTRUCTION STAGES



STRUCTURE AS IT APPEARED ON APRIL 28, 1915



A RECENT VIEW INDICATING THAT THE CONCRETING WORK IS N EARING THE ELEVATION OF THE FINISHED CREST is at present in charge of the preliminary work on a sewer system for Cleveland, Tenn.

E. F. Saxton, formerly acting supervising engineer of the permit bureau of the Bureau of Highways of Philadelphia, has been appointed assistant director of wharves, docks and ferries of that city. He is a graduate of Lehigh University and has served on the engineering forces of the New York Central Railroad, the Chicago & Northwestern and the Mexican Central.

J. H. Moore, commissioner of public works and city engineer of Evanston, Ill., tendered his resignation July 1, same to be effective Sept. 1. He has occupied the office continuously for sixteen years. At the meeting of the City Council, July 6, at which the resignation was acted upon, his services were highly commended and it was unanimously voted that he be given a leave of absence of thirty days, with full pay, as a token of appreciation. He retires to accept another position.

H. M. Montgomery, chairman of the Chicago section of the American Society of Mechanical Engineers, has been elected vice-president and director of the Powdered Coal Engineering and Equipment Company of Chicago. The company is preparing plans for the construction and equipment of a large demonstration plant and research laboratory in Chicago, where working demonstrations of the adaptation of powdered coal to all forms of furnace heat production will be carried on under engineering observation.

Allen F. Sherzer, assistant in hydraulic machinery at the University of Michigan, is doing summer work as construction engineer for the National Gas & Electric Company of Detroit, in charge of the construction of a steam electric plant at Bucyrus, Ohio. The plant when completed will contain a 600-kw., 4-stage, General Electric Company turbine and boilers of the Wicks vertical type, equipped with Foster superheaters. It will replace the old gas engine plant now in use. A dam is under construction in the Sandusky River to divert water for condensing purposes.

Fred C. Smith has resigned from the office of city engineer of Sioux City, Iowa, to become consulting engineer for the Philip Carey Company of Cincinnati. His first engineering experience was in the city engineer's office at Sioux City, where he served from 1887 to 1895. He was assistant on the survey of the State line between Nebraska and South Dakota during the two years succeeding, and returned to Sioux City in 1898 as assistant city engineer. He served in the latter office until 1909, when he resigned to become a member of the engineering firm of Smith & Finley. He was appointed city engineer of Sioux Falls in 1911.

Edgar A. Kingsley, consulting engineer, of Temple, Tex., formerly supervising engineer of the Bell County (Tex.) highway system, and previous to that State highway engineer of Arkansas, has been appointed paving engineer of San Antonio, Tex. He was graduated from Purdue University in 1893 and from then until 1904, when he was appointed superintendent of public works of Little Rock, Ark., was engaged principally in railroad work. He entered private practice as consulting engineer in 1911, acting also as consulting engineer for the Pulaski County (Ark.) road division. He was appointed highway engineer of the State in 1913.

Irving C. Brower, division engineer of the Chicago & Alton Railroad at Bloomington, Ill., was named by Mayor Pearsons of Evanston, Ill., as commissioner of public works and city engineer, to succeed J. H. Moore, whose resignation is noted elsewhere in these columns, at the meeting of the City Council held July 6. Mr. Brower was graduated from Cornell University in 1901 and had two years' experience in municipal work in Philadelphia previous to taking up railroad work in 1903. Since then he has been engaged principally in the latter class of work with the Philadelphia, Baltimore & Washington, the Norfolk & Western, William Wharton, Jr., & Company of Philadelphia, the Kansas City, Mexico & Orient, the Mexican International, the Missouri Pacific and the Chicago & Alton.

Isaac W. Geer, formerly superintendent of the Cleveland & Pittsburgh division of the Pennsylvania Lines West of Pittsburgh, has been appointed general superintendent of the Central system, with headquarters at Toledo. He was graduated from Yale University in 1895 and entered railway service as rodman on the Pennsylvania in the fall of that year. In 1898 he was appointed assistant engineer in the maintenance-of-way department of the Erie and Ashtabula division and engineer of maintenance of way in 1900. He attained the grade of superintendent of the Terre Haute & Logansport and the Logansport & Toledo railways in 1904.

Benjamin F. Cresson, Jr., formerly chief engineer of the New Jersey Harbor Commission, was appointed chief engineer of the Board of Commerce and Navigation of the State of New Jersey at its organization meeting, July 1. He received his professional education at Lehigh University and the University of Pennsylvania and served on the engineering forces of the Lehigh Valley Railroad from 1894 to 1897, successively as chainman, rodman, draftsman and instrument man. In 1897 he was appointed transitman on the construction of the Reading subway in Philadelphia and, in 1900, assistant engineer in the office of Jacobs & Davies, consulting engineers, of New York City, on preparation of plans, specifications and estimates for the proposed tunnels for the Long Island Railroad under the East River, New York City. He was appointed first deputy commissioner of docks and ferries of New York City in 1910 and resigned from that position in 1913 to become chief engineer of the New Jersey Harbor Commission.

Joachim G. Giaver, who for the past seventeen years has been chief engineer of structural design and foundations for D. H. Burnham & Company, announces that he has left that concern and opened offices for the practice of consulting engineering at 751 Railway Exchange Building, Chicago, where he intends to specialize in structural design, foundations and building engineering. He is a graduate of the Technical College at Trondjheim, Norway. He came to America in 1882. One of his early jobs in the new country, while chief engineer, from 1883 to 1890, of the Shiffler Bridge Company of Pittsburgh, was the iron supporting frame for the Statue of Liberty on Bedloe's Island, New York Harbor. When assistant chief engineer of the World's Columbian Exposition in 1892, he designed the three-hinge arch in the Manufacturers and Liberal Arts Building which is still the largest building arch in the world. Mr. Giaver's latest work has been in connection with the new forty-story Equitable Life Building in New York City.

L. R. Jorgensen, the inventor and patentee of the constant angle multiple radius dam, who has been associated for the past eight years with the engineering firm of F. G. Baum & Company of San Francisco has resigned to engage in a general electric and hydraulic engineering practice, specializing in the design of arch dams, with office in the Chronicle Building, San Francisco. He was graduated from Technikum Mittweida, Germany, in 1900 and, after a few months spent in special studies, engaged as draftsman and calculator on electric railroad systems in that country. He came to the United States in 1901 and served a few months as draftsman with H. G. Layng, consulting engineer, of New York City, after which he entered the employ of the General Electric Company at Schenectady, N. Y. In 1903 he was appointed construction engineer on power plant installations for the Edison Electric Company at Los Angeles, Cal., in which capacity he served until 1905, when he was engaged by the Abner Doble Water Wheel Company of San Francisco. He left this service to accept a position with the California Gas & Electric Corporation on hydroelectric work. He became associated with F. C. Baum & Company in 1907, in which capacity he developed the constant angle multiple radius dam which was used in the design of the Lake Spaulding Dam, described in the Engineering Record, Aug. 9, 1913, page 150.

Henry D. Dewell, formerly connected with Galloway & Markwart, consulting engineers, of San Francisco, and, for the past three years, chief structural engineer of the Panama-Pacific International Exposition, has opened offices in the Holbrook Building, San Francisco, for the practice of civil engineering. He was graduated from the University of California in 1906, and was engaged from then until 1909 with Howard & Galloway, architects and engineers, of San Francisco, as draftsman on steel frames and foundations for various buildings, including four for the Alaska-Yukon-Pacific Exposition, as assistant to J. D. Galloway, on designs and estimates for pipe lines, reservoirs, flumes, power-houses and dams, as head draftsman of the engineering department and resident engineer. In the latter capacity he had charge of the design of steel frame buildings aggregating in cost $3,000,000, and a $350,000, 400-ft. draw-span bridge at Sacramento for the Northern Electric Railway Company. He also served as assistant in general hydroelectric work, including investigations of various power propositions.

Edward F. Vincent, formerly assistant chief engineer of the Colorado & Southern Railway, has been appointed chief engineer with headquarters at Denver. He was graduated from the State University of Iowa in 1884 and entered railway service as draftsman and field assistant on the forces of the Union Pacific in 1886. In 1887 he was appointed engineer of construction on the State Capitol Building at Denver. He occupied this office for about three months, then returned to the Union Pacific. In 1889 he was engaged for a short period with the U. S. Geological Survey, after which he was appointed principal assistant engineer for the Board of Public Works of the city of Denver. He was resident engineer for the Fort Worth & Denver City Railway from 1900 to 1903 and assistant chief engineer of the Wyoming State Railway and its successor, the Chicago & North Western, in 1904. From 1905 to 1906 he was with the Missouri Pacific as assistant engineer on surveys and later as engineer of construction in the general office at St. Louis. He was appointed assistant chief engineer of the Colorado & Southern in 1906.

Obituary Notes

Frank Amherst Bowen, vice-president of the Concannon Engineering Company, San Francisco, died recently at his home at Oakland, Cal.

William L. Criglar of the San Francisco city engineering department died of heart trouble, July 1. For many years Mr. Criglar was superintendent of the Fulton Iron Works of San Francisco, which position he left just after the fire in 1906 to enter the engineering department of the city. He had personal charge of the installation of the high pressure water system and pumping stations and carried much of the responsibility in the construction of the Municipal Street Railway extension for handling the exposition traffic.

Joseph A. Holmes, director of the U. S. Bureau of Mines, died in Denver, Col., July 13. He entered the government service in 1904 when appointed by President Roosevelt to take charge of the U. S. Geological Survey laboratories for the testing of fuels and structural materials at St. Louis and Pittsburgh. Previous to that he was professor of geology at the University of South Carolina and also State geologist of that State. He took a deep interest in the good roads movement in Georgia and was instrumental in the passing of a law by which the counties could have the work of their own convicts for road construction and repairs.